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APRIL 1980
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Coming Next Month

• The May issue of **db** features new developments in sound reinforcement. Included in the issue is an article entitled "Reinforcing the Pope in Boston," which tells of the trials and tribulations of installing a p.a. system for an outdoor Papal Mass with tens of thousands in attendance. Also, Mike Rettinger tells us more about outdoor sound reinforcement in Sound Reinforcement in Amphitheaters." Sound interesting? You bet! Check out next month's edition of **db—The Sound Engineering Magazine.**

About The Cover

• Drawing by Kathleen Erin Lee, Advertising Production Manager of **db** and artist-by-preference, depicting the Nashville theme through familiar characters (reckon y'all can tell it's Dolly Parton and Kenny Rogers). For more information on Nashville and what goes on in Music City, USA, just read on and let Sam Zambuto tell you all about it.

db

THE SOUND ENGINEERING MAGAZINE

APRIL 1980 VOLUME 14, NUMBER 4

db is listed in **Current Contents: Engineering and Technology**

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db Letters

TO THE EDITOR:

My letter, which appeared in the **db** letters column, November 1979 issue, began life as a personal communication to Norman Crowhurst. I did not write it in a form I considered appropriate for a letter-to-the-editor and did not submit it as one since I had no particular desire to expose what appeared to be a misconception on Mr. Crowhurst's part to public view. The letter was later modified by someone else to make it appear that I wrote it for publication in **db**, and it was then published without any notification to me.

Now that the letter, dealing with nonlinear distortion reduction, has, in fact appeared, along with a reply from Mr. Crowhurst, a reply to his reply seems needed.

The purpose of my original letter was to point out that Crowhurst's statement (**db**, July 1979), "In fact, however distortion gets in, you cannot take it out again," was in error. I cited references that show that, in fact, nonlinear distortion can be undone. Mr. Crowhurst elected not to fight on this lost battlefield. Instead, he stated, "This letter repeats a misconception that has come up before." Unfortunately, he never told the reader exactly what that misconception was or where it appeared in my letter (a neat way to turn the tables!).

Mr. Crowhurst in his response to my letter devotes considerable space to a discussion of pulse or frequency response distortion and how it might be corrected. But such *linear* distortion has nothing to do with the nonlinear distortion situation which was the subject of my letter and which led Mr. Crowhurst, during a discussion of compressors and expanders (nonlinear devices), to his ill-considered statement quoted in my original letter and repeated above.

Mr. Crowhurst seems to imply that the misconception (mine, not his) was that I believed it to be possible to reduce or eliminate nonlinear distortion without prior knowledge of the form of the distortion. This was a well-constructed straw man, and it gave Crowhurst an opportunity to reply in public to my letter without admitting any mis-statements on his own part, but it remains a straw man. His original statement is still incorrect when this point is acknowledged, and the entire point of the series of papers I wrote in the late '50's and early '60's on nonlinear distortion reduction (cited in my original letter) was that *knowing* the form of the nonlinear distortion law, one could often greatly reduce the resulting nonlinear distortion

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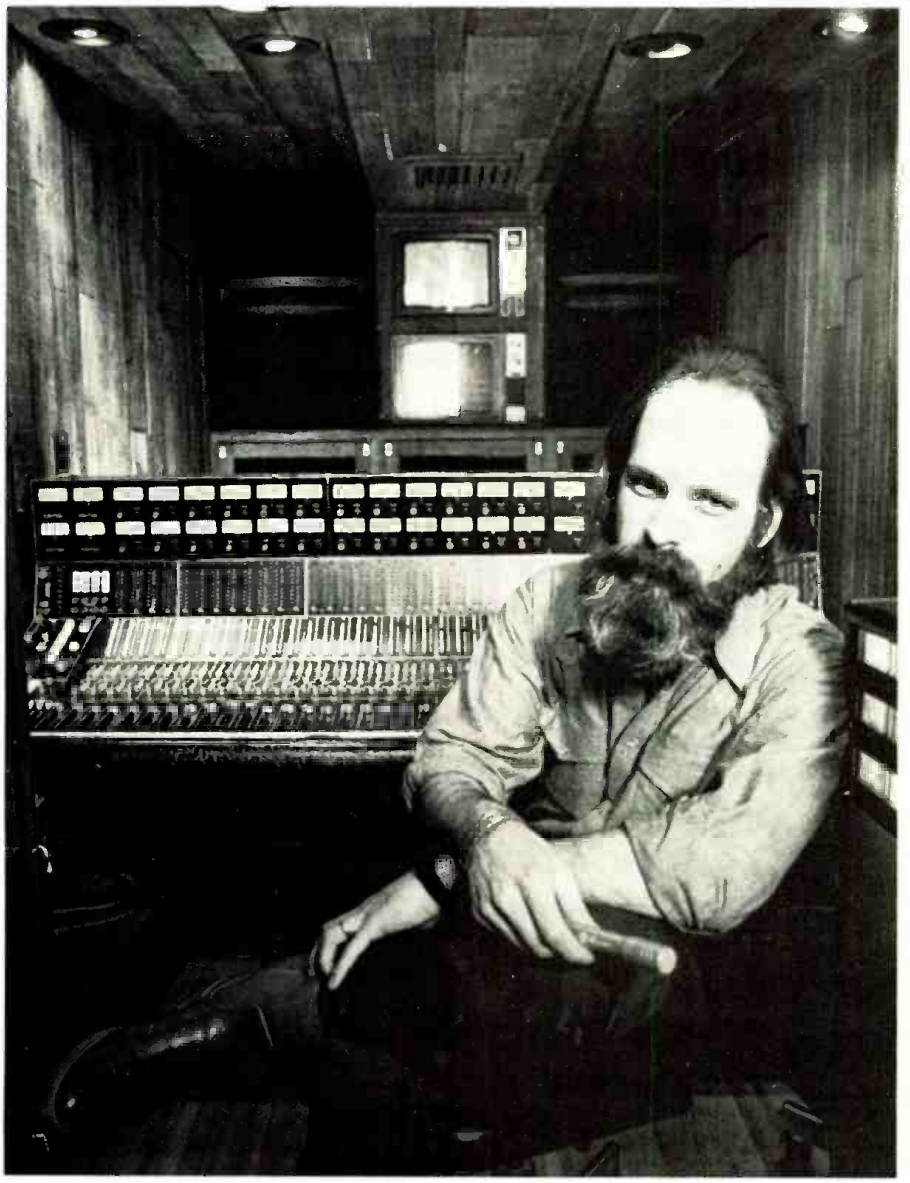

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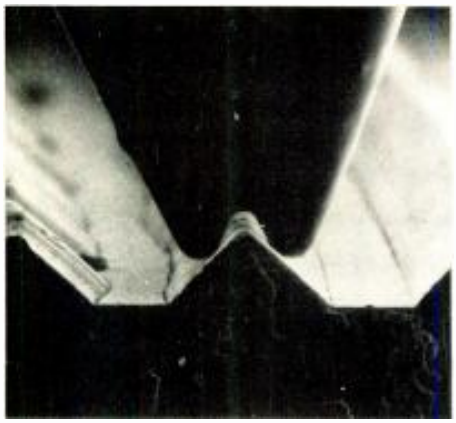

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by either pre- or post-distortion of correct complementary character.

The misconception, if any, seems to be Mr. Crowhurst's in imputing a misconception to my letter and its antecedents which did not exist. He could have performed a useful service for the readers of **db**, instead of creating a red herring and beating it to death, if he had discussed the positive rather than the negative side of the matter. For example, he could have pointed out how the signals cut into phonograph records are usually predistorted (nonlinearly) to reduce the distortion produced on playing the records (a good application of the teachings of my papers). Also in these days when many power amplifier designers strive strongly to limit the amount of negative feedback used (to improve TIM response), Mr. Crowhurst might have pointed out how nonlinear predistortion in the driver stages of a stereo amplifier can again very appreciably reduce the nonlinear distortion in the output signal, reducing the amount of feedback required. These are both examples where the form of the distortion law may be determined experimentally quite accurately, and complementary distortion used effectively to reduce overall distortion. Contrary to the implication in Crowhurst's reply, it is *not* necessary that complementary distortion systems make use of the undistorted input signal to do their job and reduce distortion. The system only requires knowledge of the *form* of the nonlinear distortion law obeyed by the primary distorting element or subsystem.

I hope that the distortion-reduction waters muddied by Mr. Crowhurst's reply have been somewhat clarified and that his red herrings can now be left to die peaceful deaths.

J. Ross Macdonald
(William R. Kenan, Jr. Professor of Physics)

To The Editor:

In my December, 1979 article in **db**, "Stereo Microphone Technique," brevity prevented a fuller discussion of some phenomena. Here are a few additional comments.

The more directional the microphone pair, the wider the reproduced stereo spread, for a given angling and spacing between microphones.

Figure 5: Off-center phantom image locations produced solely by time differences are rather vague and hard to localize.

Figure 7: The reproduced stereo images for the reverberant recording room were closer to the center than those of the anechoic recording room. That is, reverberation tended to narrow the stereo spread. A microphone technique which gave accurate localization when used in the reverberant room, with a 90-degree orchestral width, was the N.O.S. system (90-degree-angled, 12-inch-spaced cardiods).

Two condenser microphones set to a bidirectional pattern were used for the Blumlein technique recording. Quite likely, a pair of ribbon microphones, with better 90-degree cancellation, would provide more accurate localization.

In Figure 7, the stereo spread shown for the first three microphone anglings (90, 120, and 135 degrees) is a misprint. The actual stereo spread was slightly narrower than shown.

Conclusion, page 46: Increasing the angle between directional microphones will make the orchestra sound farther away. Increasing the spacing between microphones will not.

Bruce Bartlett
Development Engineer,
Shure Brothers Inc.
Evanston, Illinois

To The Editor:

I read with interest Kirk Elliott's article describing a cable tester for mike leads (Dec. '79). Perhaps I could share with readers a small cable tester that was developed to meet our needs with the Royal Canadian Mounted Police Band. We currently use 32 channels of P.A., and a fast method of checking the integrity of the cables and snake from board to stage was a must. By wiring a subminiature led and 2.2k resistor in series from each side of the line to ground, and mounting the whole thing in a male XLR with the led's protruding through the cable clamp, the presence of 48V phantom power can be detected right at the connection to the mike. While this will not show a phase reversal or a short between pins 2 and 3, it does give a very quick check of the line, as it can be carried around in the pocket while setting up the mikes and tapping them out.

Cst. Peter G. Carss
Royal Canadian Mounted Police Band
"N" Division
Ottawa, Canada

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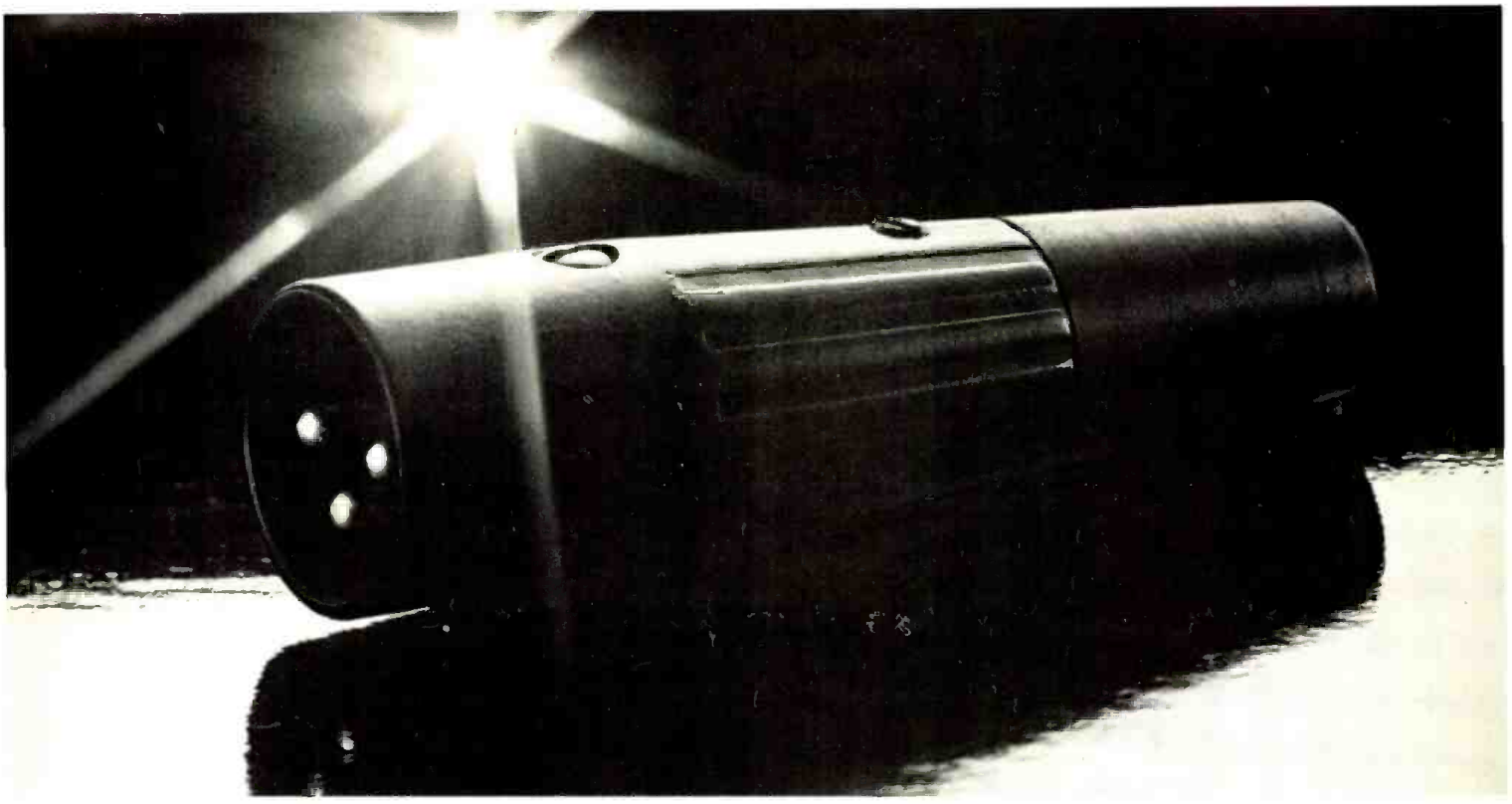

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db Calendar

APRIL

28-5/1 **Audio-Visual '80 Exhibition & Conference.** Wembley Conference Centre, London, England. For more information contact: British Information Services, 845 Third Avenue, New York, NY 10022, (212) 752-8400.

MAY

3 **1980 Midwest Acoustics Conference.** Chicago, Illinois. Topic: Microphone Techniques for Recording and Broadcasting. Place: Hermann Hall, Illinois Institute of Technology, Chicago, IL. For more information contact: Tony Tutins, Knowles Electronics Inc., 3100 North Mannheim Rd., Franklin Park, Illinois 60131. (312) 455-3600.

6-7 **B&K Measurement Seminar—Audiometer Calibration.** B&K Instruments, Inc., 5111 W. 164th St., Cleveland, Ohio 44142. Telephone: (216) 267-4800.

6-9 **AES 66th Convention** (Los Angeles). Los Angeles Hilton, Los Angeles, California. For more information contact: Audio Engineering Society, 60 E. 42nd St., Room 449, New York, NY 10017.

27-30 **B&K Measurement Seminar—Quiet Product design.** B&K Instruments, Inc., 5111 W. 164th St., Cleveland, Ohio 44142. Telephone: (216) 267-4800.

JUNE

15-18 **1980 International Summer Consumer Electronics Show (CES),** Chicago, IL. McCormick Place, McCormick Inn, and Pick-Congress Hotel. For more information contact: William T. Glasgow, Vice President, Consumer Electronics Shows, Two Illinois Center—Suite 1607, 233 N. Michigan Avenue, Chicago, Illinois 60601 (312) 861-1040.

19-20 **APRS '80** International Exhibition of Professional Recording Equipment. Connaught Rooms, London, England. For more information contact: British Information Services, 845 Third Avenue, New York, NY 10022, (212) 752-8400.

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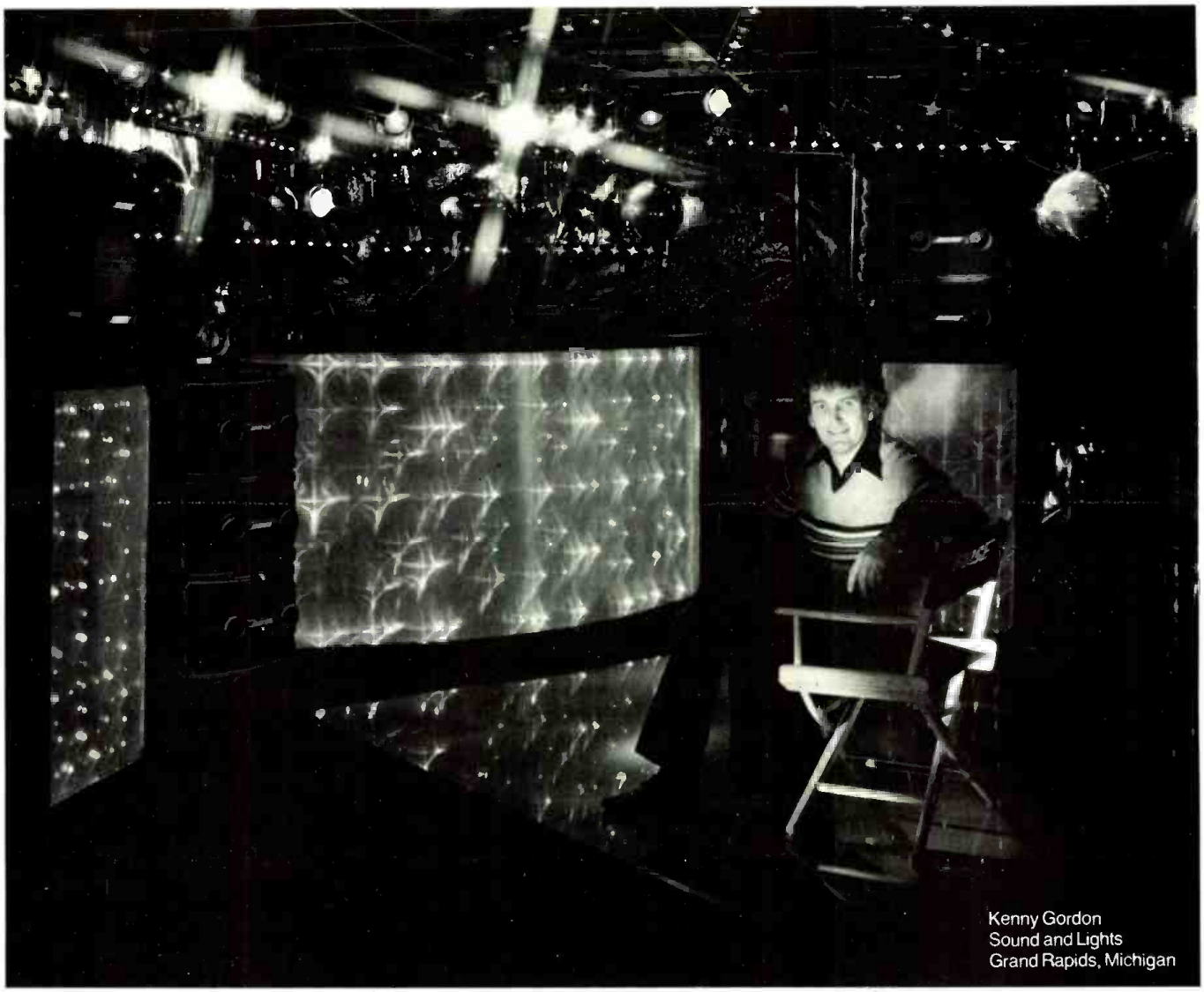

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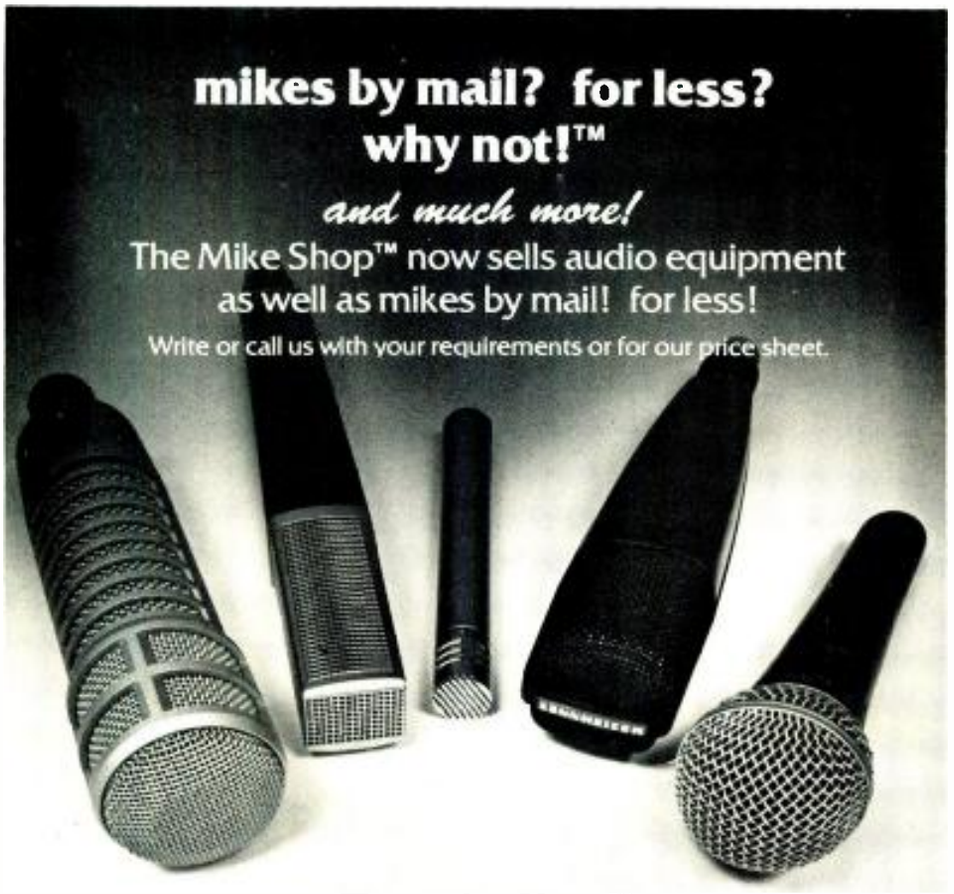

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JULY

1-3 **Transducer and Temperature Control Exhibition** will be held at Wembley Conference Center, London, England. For more information contact: British Information Services, 845 Third Avenue, New York, NY 10022, (212) 752-8400.

25-27 **American Radio Relay League 26th Convention,** Seattle, Washington. Registration and program information may be obtained by writing 1980 ARRL National Convention Committee, P.O. Box 58534, Seattle, Washington 98168.

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NORMAN H. CROWHURST

More About Nature and Technology

• Now that audio is getting into digital, it becomes more interesting to study how natural hearing works, and to notice the links with other natural physical phenomena. For decades—possibly centuries—the medical profession has known quite a lot about the structure of the human ear, which has commonly been divided into three parts. This excludes what happens at the other end of the auditory nerve, in the brain, where all that happens in the ear gets interpreted as sound.

The subjective studies of hearing conducted by Fletcher and Munson, and confirmed more recently by other experiments, must have made you suspect that somewhere in the human hearing faculty there must be an automatic gain control. The enormous dynamic range is one element that would suggest this. Some 100 to 120 decibels, which represents a sound pressure range of between 100,000 and 1,000,000 to 1.

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Reverting to the structure of the ear, so we have a picture of the whole thing, before we get down to this detail, the outer ear, which is what you see on a person's head, contains the "auditory canal," that little hole where sounds go in. At its other end is the tympanic membrane, or eardrum, which divides the outer ear from the middle ear.

The middle ear consists of a series of three very tiny bones, comparable in size with modern phonograph styli. The first of these, in the sequence of transmission, is shaped like a hammer. The handle end attaches to the eardrum, while its shorter end couples to one shaped like an anvil. The other end of the anvil-shaped bone connects to one shaped like a stirrup, which in turn is coupled to another diaphragm, covering what, from its shape, is called the oval window.

This, anyone who has studied acoustic mechanisms will recognize, is an acoustic matching transformer. On the other side of the oval window is fluid, through which acoustic vibrations are transmitted in the mechanism of the inner ear, which we will describe in a moment. But the interesting thing is that these little bones of the middle ear have a series of muscles that, among other things, tighten or relax the tension of the eardrum.

So, when you are listening to sounds near the threshold of hearing, your eardrum is relaxed, moves very easily in response to acoustic vibrations reaching it. But when sounds of higher intensity strike the eardrum, these muscles tense up the ear drum, so it moves against a much stronger controlling force, preventing the first step of "overload" that would otherwise occur.

But these muscles also appear to change the "transmission ratio" of the acoustic transformer formed by the three little bones, so that a greater step-down in movement occurs with high intensity sounds. Fairly obviously, the AGC action produced by this means affects all frequencies equally, because it works to prevent overload of the later mech-

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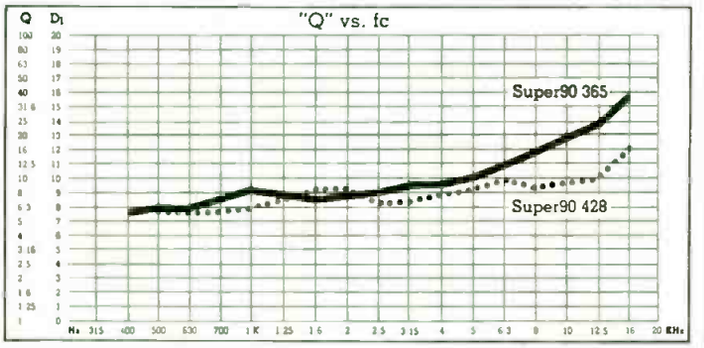
OUR BEST YET. This horn is by far the most well behaved ninety degree radial horn we've made—and we've designed a few winners. Super90's are highly efficient; exhibiting smooth axial directivity with no vanes, obstructions or diffraction effects in the critical throat area. The result? A smoother, cleaner sound, but with a new dimension added.

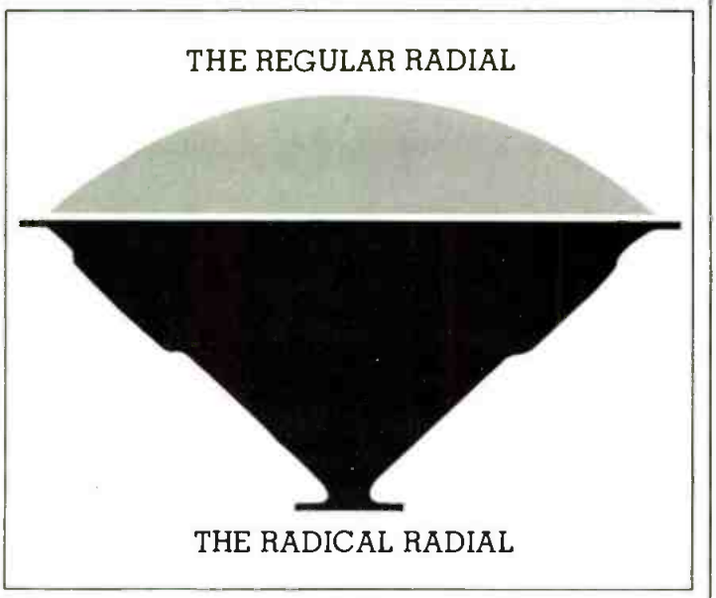


A NEW DIMENSION? Yes. *It's flat.* The front of this superb horn doesn't curve back in the familiar arc, it's flat, with straight, rectangular sides that make box mounting a snap and set-ups a breeze.

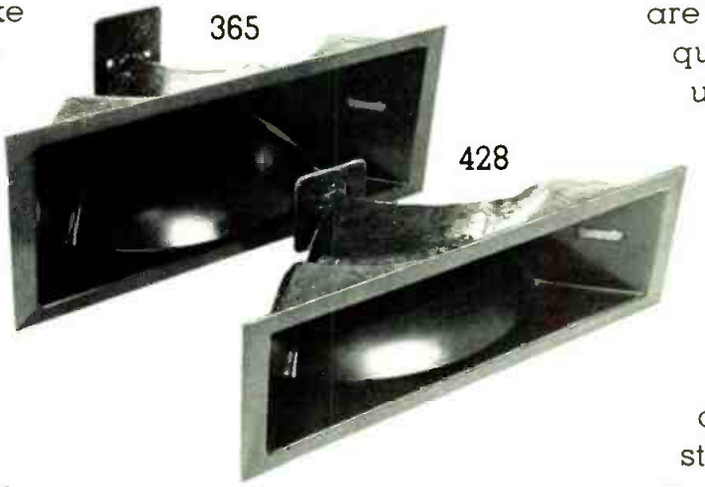
It's compact—measuring at least 7" less in depth from driver mount to the front of the horn.

It's stronger—greater structural rigidity means even less resonance than that of our standard radial designs.

We have two **Community Super90** horn designs available—**the Super90/365** (flare rate 365Hz, operating range from 600Hz and up, for 2" exit compression drivers) and the **Super90/428** (flare rate 428Hz, operating range 800Hz and up) which accepts 1" exit loudspeakers.



Community Super90's are the correct choice wherever a predictable, compact 90° radial is needed. Flush-mounted system installation is greatly simplified with the use of Super90's. In tour applications these horns are easily mounted in multiples and are the ideal solution for quick, hassle-free set-ups.



Community Super-90's provide you with the best of both worlds—radial horn performance superbly coupled with the packaging convenience of a straight horn.

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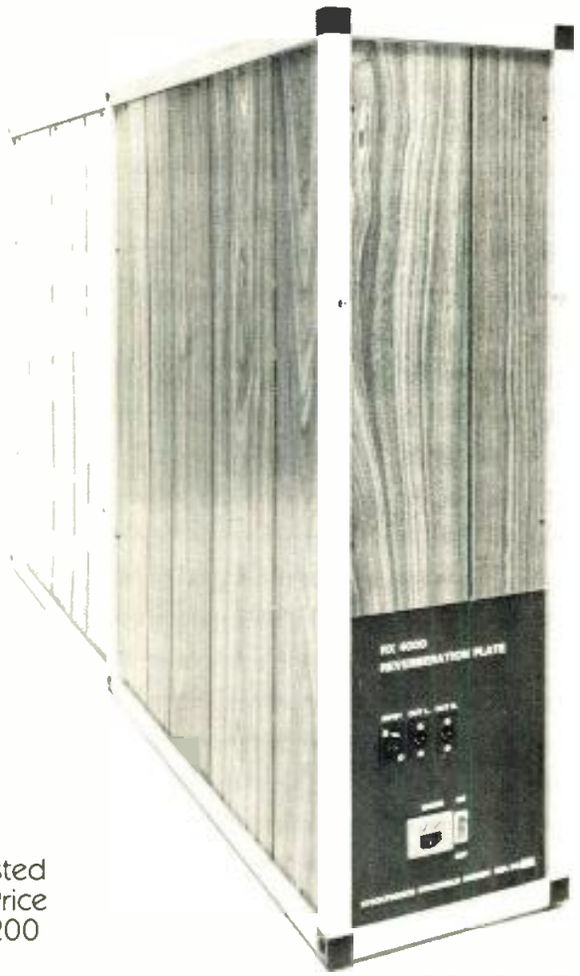

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anism, and to "turn down" the whole signal delivered to the inner ear.

"ANALOG-DIGITAL" HEARING

In terms of analog or digital, the hearing mechanism as we have thus far described it, functions as an analog device: movement of the mechanism follows the waveform of the sound pressure waves received by the eardrum. But can that AGC mechanism handle the enormous range observed without any further reactive control? Try and think of a microphone with an electromechanical AGC mechanism, that would produce an adequate input for an amplifier, from a sound near threshold level, without overloading it when the sound level steps up by from 100 to 120 dB, and you will see the problem.

Now, the inner ear consists of what is inside the cochlea. This is a bone structure shaped like a tiny snail's shell. Inside, running the length of the spiral, is a membrane, called the basilar membrane, that separates two channels, called the vestibular scala and the tympanic scala. At the lower, or broad end of the snail's shell, these channels terminate in the oval and round window, respectively. So vibrations imparted to the oval window by the stirrup bone move the fluid inside, which in turn moves the round window, after doing some other things, that are responsible for transmitting impulses to the brain, about these vibrations that we call sound.

The basilar membrane consists of a series of fibers tensioned from the inside to the outside of the helix, crossways on to the channels. Thus vibrations imparted to the vestibular scala fluid must somewhere move the basilar membrane, to move the fluid in the tympanic scala. As these fibers are in tension, they behave like tuned reeds. But it should be obvious that such tiny reeds could never, by themselves, resonate to frequencies that we recognize as sound, from 20 hertz to 20,000 hertz, or something approaching those figures. Think of a harp: how could a mechanism like a harp be compressed into a very tiny snail's shell?

FLUID ASSISTANCE

If you were thinking in terms of the harp analogy, you probably would expect the low-frequency resonators to be at the big end of the spiral, and the high frequency resonators to be at the small end. But that is not the way it is. What makes the difference, is the incompressible fluid, in contact with these fibers. The fluid has to move with them—as well as it being the fluid that provides the moving force.

Perhaps a water-bed is a better analogy. Think of the inside as being like a very tiny water bed, except that instead of having the water-bed mattress placed on a single solid surface, you have two mattresses between two solid surfaces, and the interface between the two bodies

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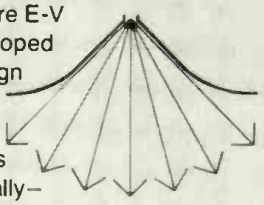
con·stănt di·rec·tiv'i·ty

The characteristic of a horn that directs all of the frequencies where you want them to go.

Most horns offer some control of the sound pattern they produce. The problem is that frequencies at the center of the pattern are different from those at the edges.

Unless you use **HR Constant Directivity** *horns, that's the problem you'll have.* To the audience this means unintelligible, too bright, too dull, and sometimes just plain bad sound at many seats.

These patented[1] **HR Constant Directivity** horns from Electro-Voice provide full-range frequency coverage and effectiveness of pattern control unheard of before E-V engineers developed this unique design concept.



Demand for the "white horns" has grown dramatically—almost completely by word-of-mouth. Once a sound engineer, musician or facility owner hears the difference **HR Constant Directivity** makes, a new demand is created.

Ask someone who has used or heard them, or buy a pair and try them yourself. You'll probably hear that HR horns are so clearly superior that other choices are obsolete.

Write to Electro-Voice for more information. We'll send you a complete set of Engineering Data Sheets and a paper comparing the today performance of HR constant directivity horns with yesterday's promises. Include $1 with your request, and we will put you on the mailing list for the E-V "PA Bible," a down-to-earth series of papers on the selection and application of professional PA products and concepts!

[1]U.S. Patent Number 4071112

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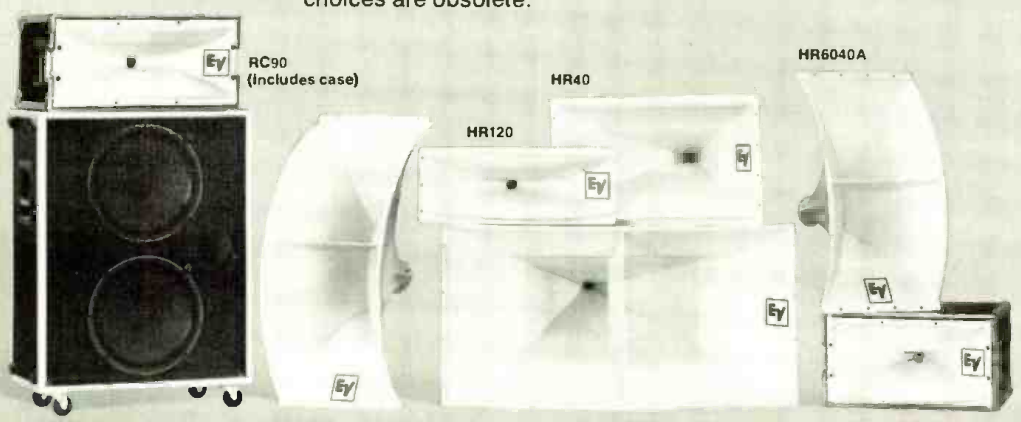

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of fluid, movable. Do you get the picture? Now, when the frequency transmitted to the oval window is very high, it moves only a very short length of the fluid, having correspondingly small mass, to a membrane that transmits the motion to the other column of fluid and out the round window.

But a low frequency on the other hand, moves most of the fluid in both channels, and a membrane up near the end of the helix transmits this motion from one channel to the other. And this amount of fluid can respond to a frequency down to the region of 20 hertz.

Now, in contact with this basilar membrane is the mechanism that converts the information in vibrational form, to nerve impulses that go to the brain in digital form. We have already talked about the dynamic range of human hearing, from 100 to 120 dB: now let us think about frequency range. It covers 10 octaves, more or less. We'll accept that tone intervals, that seem uniform, by which we would imagine them to be arithmetic, are logarithmic, as a fact of life, just as intensity changes are observed logarithmically, too.

So we could assume, whether true or not, that a given increment of distance along the cochlear spiral represents a uniform logarithmic increment of pitch, rather than frequency. But now, each octave is divided into 12, easily recognized semitone intervals, making 1200 separate tones—assuming nothing between tones is discernible. Musicologists divide each semitone into 100 cents, and a good musical ear can hear a shift in pitch of a few cents.

This means that our ears, in addition to hearing such an enormous range of intensity levels, can discriminate between a quite large range of frequencies, as well. And on frequency, we are far more critical than we are on level. You probably see why, now. The AGC action tends to "swamp" sensitivity to intensity changes. But the frequency detection system can be very critical.

Now, let us think a little further, about the relationship between the analog and digital transfer mechanism, and what the brain can do with it. For now, we will not worry about how it does it: it is a very sophisticated, and highly educated (we each spent our life training it, so to speak) interpretive mechanism; but rather about the information available from the auditory nerve system, with which it does it.

BASILAR TRANSFER

When a signal, of a single tone frequency, is minute, it may move only one basilar membrane fiber sufficiently to stimulate a nerve response. If the same frequency is increased in intensity, that fiber will move more, stimulating more nerves through their hair-cell endings, not only those in contact with that particular fiber of the basilar membrane, but those in contact with adjoining fibers. For, as the signal gets stronger, it will make a bigger segment of the basilar membrane move, to transmit the fluid movement from one side to the other.

Signals communicated along nerves do not vary materially in intensity: they are either there, or not there, like digital impulses in a digital system. But when a mass of signals comes in, along nerves from a particular locality of the membrane, this provides the brain with information it interprets as a much "louder" sound at that frequency.

Larger amplitudes of movement of an individual basilar membrane fiber may increase the number of nerves over which impulses are sent from that fiber, as well as starting impulses from nerves from adjoining fibers. And it may also increase the repetition rate of the impulses where the movement is largest. In any event, our hearing interpretative faculty has "information" from this locality to tell us approximately how "loud" the tone is.

Now, acoustically, the vibrations that communicate sound can be analyzed only by frequency and amplitude, over time. So if two musical instruments are playing in unison, how is it that a musical ear (at least) can "separate" the tones produced by each instrument, at the same pitch? From a pure frequency-analysis

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If Technics RS-1500 meets the high standards of A&M Records, why did we improve it?

After the music is recorded, and before it becomes a record, how do the top executives of A&M Records listen to Peter Frampton, Chuck Mangione, and their other stars? On the Technics RS-1500. Why? Because of its outstanding frequency response, constant tape speed and low wow and flutter. In fact they were so impressed, A&M Records bought seven more.

Now, with Technics RS-1520, you can have the same performance A&M Records has with the RS-1500, plus these extra features studios want. Like adjustable front panel bias and equalization controls. A 1kHz/10kHz test-tone oscillator for accurate equipment checks. The precision of ASA standard VU meters with a +10dB sensitivity selector. A Cue/Edit switch for quick, safe edits. And balanced low-impedance, XLR-type output connectors to match other widely used broadcast and studio equipment.

Like all our open reel decks, the RS-1520 has Technics "Isolated Loop" tape transport system. By isolating the tape from external influences, our "Isolated Loop" minimized tape tension to a constant 80 grams. This not only provides extremely stable tape transport and low head wear, it also reduces modulation noise to the point where it's detectable only on sophisticated testing equipment.

Electronically, the RS-1520 is equally sophisticated. And the reasons are as simple as IC full-logic controls. A highly accurate microphone amplifier. FET mixing amplifier. And separate 3-position bias/EQ selectors.

The RS-1520. It meets the high standards of A&M Records for the same reasons the RS-1500 does: FREQ. RESP.: 30-30,000Hz, ±3dB (−10dB rec. level) at 15ips. WOW & FLUTTER: 0.018% WRMS at 15ips. S/N RATIO: 60dB (NAB weighted) at 15ips. SEPARATION: 50dB. START-UP TIME: 0.7 secs. SPEED DEVIATION: ±0.1% with 1.0 or 1.5 mil tape at 15ips. SPEED FLUCTUATION: 0.05% with 1.0 or 1.5 mil tape at 15ips. PITCH CONTROL: ±6%. TRACK SYSTEM: 2-track, 2-channel recording, playback and erase. 4-track, 2-channel playback.

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point of view, that shouldn't be possible. But musicians do it all the time.

It derives from this fact that the interpretative faculty of the brain recognizes groups of nerve impulses, rather than a single one for each frequency, of varying intensity, as its electronic counterpart did, at least until recently. This is where digital, as it is used in the biology of our hearing faculty, serves better than its analog counterpart, developed in earlier electronic measuring instruments.

PATTERNS OF RECOGNITION

A musician learns to recognize the growth and decay patterns of whole groups of nerve impulses, and thus the harmonics associated with different instruments can be separated from those associated with others, even though they are all using the same set of frequencies. It is a very complicated system of decoding the "information" that the ear delivers to the brain.

In earlier times, engineers, who thought of everything in terms to which their education had accustomed them, would not believe a musician could do things like this: he had to be imagining it. And of course, the engineer listened to a collection of frequencies, while the musician listened to a collection of musical instruments (each of them from the same sound): so each could "hear" what the other couldn't!

This is why engineers with a better education did not rule out the possibility that musicians heard differently from engineers. Obviously, if a musician can "A-B" something, and tell which is which, he must be using some information that his ears provide him with to do it. If he was using guess-work, as engineers of the time contended, then his perception would have been random, quite unreliable. But the evidence showed he could hear what he claimed to hear. Now we are beginning to understand why, or how. ■

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The Model 300 is a 100-watt per channel* amp and the Model 600 delivers 175-watts per channel.*

Both feature full complementary output stages . . . modular construction . . . a high-speed 15-MHz op-amp front-end . . . individual front panel gain controls . . . stereo/mono switch . . . sophisticated loss-of-feedback clipping indicators . . . separate signal and chassis grounds . . . and rugged all steel construction. Both are also available with built-in 70/25 volt autotransformers.

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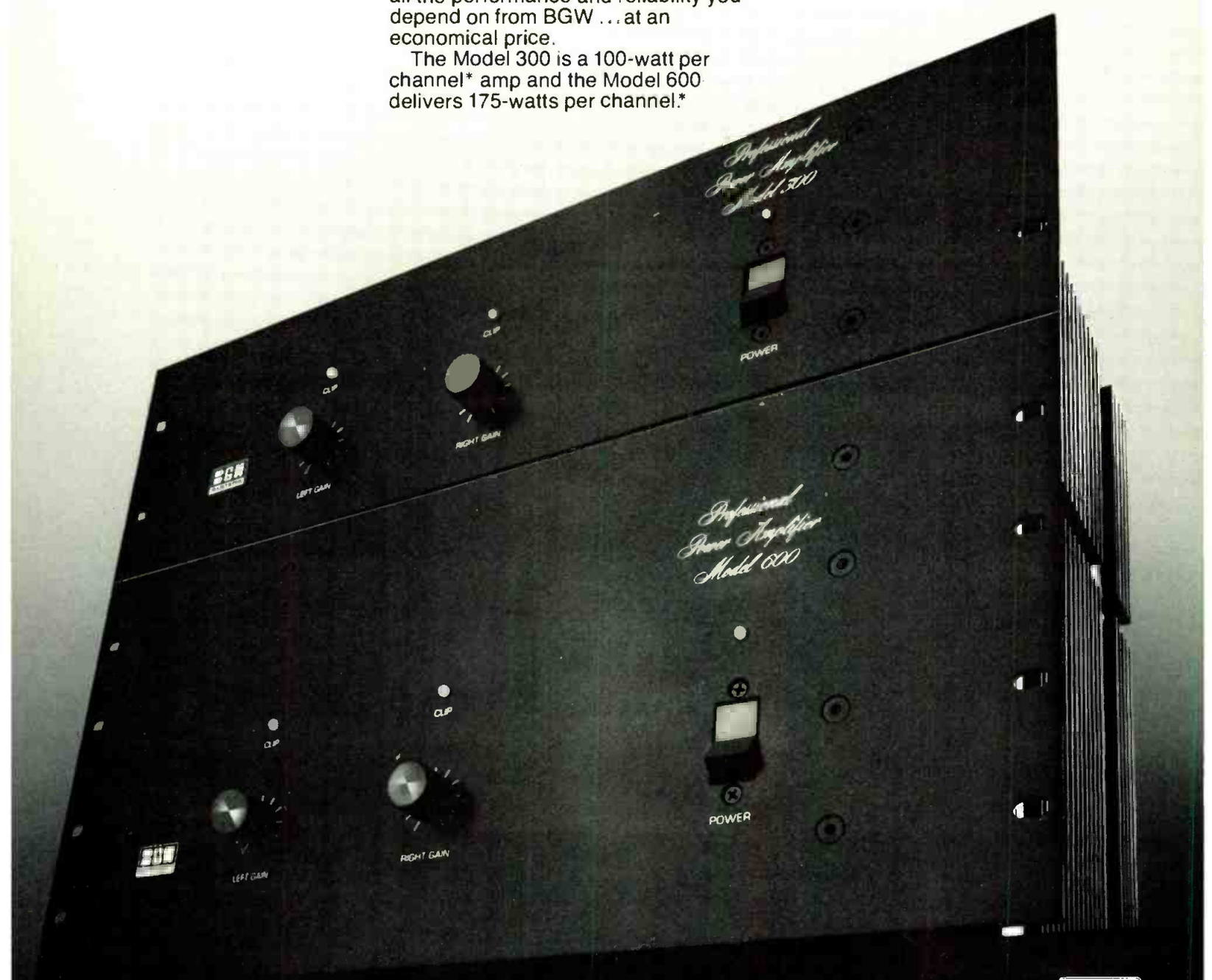
*Minimum average continuous power output at 8 ohms over the full 20 Hz-20kHz band. 4 ohm rating significantly higher.



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MARTIN DICKSTEIN

db Sound With Images

N.A.V.A.—1980

• Did all of you get to Atlanta in January this year? Some of you did, that's for sure. To those of you who did, congratulations. To those who didn't, bad luck. Better luck next year. This one was a big one.

First, let's take a look at some of the numbers. In order to accommodate all the sessions, seminars, meetings, luncheons, worship services, breakfasts, special events, workshops, etc. for the six days the entire convention and exhibit ran, six hotels and the Georgia World Congress Center were used, with shuttle bus service between them. There were 5 different colors used for the badges to help identify the category to which each of the visitors belonged, and the exhibits included almost 300 companies (some of which had more than one booth) to display and demonstrate their wares, both soft and hard. There were meetings and conferences each of the six days, but some of them were by invitation only. However, we can briefly look at some of them and the subjects they covered, just to show you the span of topics with which they concerned themselves. We'll also take a look at the exhibitors (just a sampling to whet your attendance appetite for next year) and some of the materials displayed or discussed, and then set you up with a list of upcoming NAVA conventions so you can prepare for them, starting now. You might even start thinking of taking some future vacations around these conventions when you see where they will be.

This convention, the 41st annual program run by the National Audio-Visual Association, was entitled "New Horizons in Communications." It was organized "with programs designed to help you cope with this changing world of sky-rocketing inflation and business unrest. Seminars are geared to help you face daily problems with down-to-earth practical solutions. But the 1980's will bring us some very exciting times, too. And you are sure to see this reflected on the Exhibit floor, where the latest advances in A-V communications are on display." The quote is from convention chairman Edwin F. Burke.

PROFESSIONAL DEVELOPMENT SEMINARS

On the first day, there was a series of six seminars covered by the overall title of NAVA Professional Development Seminars. These sessions are a qualifying activity of the NAVA Certified Media Specialist Program.

Seminar 1 was entitled Effective A-V Presentations. This was a how-to-do-it type of meeting with emphasis on planning and production of audio-visual materials to be used as an integral part of a presentation. Often, not enough thought is given to the design principles and technical considerations when producing these materials, so this session devoted itself to a model to follow when getting this material together for a presentation.

Seven major considerations were discussed: 1) basic characteristics of the audience, 2) communication objectives, 3) selection and organization of content, 4) instructional strategy, 5) development of message materials, 6) presentation of the content, and 7) evaluation of each facet of the total process. The keynote was integrating audio and visual elements for maximum power and impact.

NEW MARKETING APPROACHES

The second seminar concerned itself with Marketing A-V Rentals. With the convention and meeting industry growing at such a rapid pace, it has become essential that the A-V rental business grow accordingly, not only to keep up with the dizzying speed of the state-of-the-art sophistication, but with technical know-how and support to clients, service, and staffing. All this takes good business management to stay ahead. The panel in this seminar, with the help of audience participation, discussed all the ins-and-outs of the rental industry from set-up to tear-down.

Seminar 3 covered A-V Leasing as a Sales Tool. Tuned to the AV dealer, the session discussed how leasing can increase sales, how leasing can be used to reach previously unreachable markets, and how leasing can convert prospects who were unsure about purchasing.

Seminars 4, 5, and 6 dealt with Industrial Software—Market of the 80's, Selling A-V through Architects, and Selling A-V through and Advertising Agency, respectively. All were directed toward the dealers of A-V to tell them what to look for in the coming years, and how to increase sales through other than the "usual" methods.

DEALER MANAGEMENT MEETINGS

On the third day, another series of

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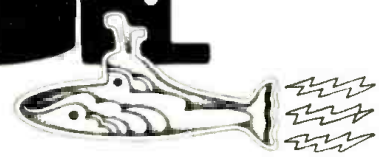
TAKE A FANTASTIC VOYAGE



Inside Tip:
The filters can be modified just by changing capacitor values to "roll-off" or "roll-on" at virtually any frequency. Result: *A Built-In Electronic Crossover.* Graphs for these modifications and others are in the owner's manual. We even made the owner's manual small enough to fit in a pocket and printed it on waterproof (and beer proof) paper.

Easy Access
6 screws hold the main board to the chassis. Only Velcro® could be quicker.

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No "jiggle" quotient.

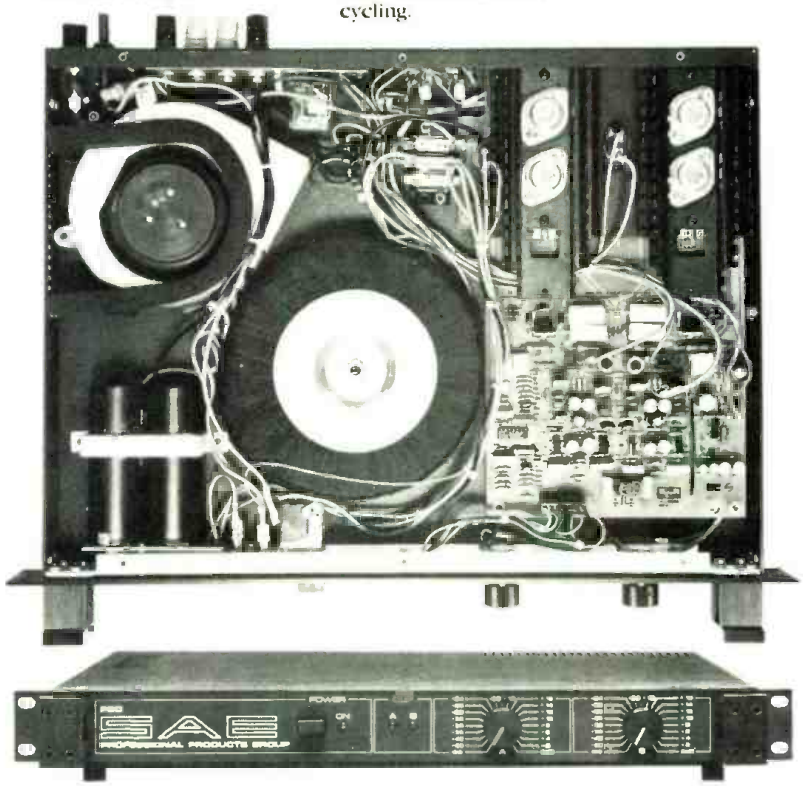
Overload Indicators
These start to flash 1dB prior to clipping at any load, at any frequency.

Toroidal Transformer
High current drive capability allows easy 2 Ohm performance. The Toroidal design also has no stray hum field, so you can put low-level stuff like preamps and digital delay lines right on top of the P50.

All Discrete, Fully Complementary Circuitry from Input to Output
If you're tired of an amplifier that sounds like a chicken being chased by a steam-roller, give the P50 a listen. . .soothes ravaged ears.

Relay
D.C. sensing protection circuit eliminates turn-on and turn-off thumps.

Fan
The P50 not only meets E.I.C. specs at 2 Ohms, but does it with no thermal cycling.



Pem Nuts
Instead of using sheet metal screws that come loose, we use Pem Nuts. Pem Nuts are threaded pieces of metal that, when bonded with the chassis, provide extra thickness and strength. Plus, we can now use a machine screw instead of the self tapping sheet metal type. . . you can take the P50 apart and put it back together as often as you want. We use Pem Nuts. . .Obviously.

Chassis of .090" Aluminum
We even have an .090" Aluminum L-Bracket running down each side to give the amp extra rigidity when rack mounted.

Low Pass Filter
A 6dB per octave filter gives the amp a 3dB down point at 25kHz to keep R.F.I. from passing through the amp and frying tweeters. If you *are* interested in frying tweeters, remove this jumper and the response goes out to a couple of hundred kilohertz. (By the way, we give you a dummy pin to store the jumper on when you want it out of the circuit.)

Power Output:
At Least 70 Watts per Channel in Stereo, @ less than .05% T.H.D.
300 Watts in Mono

High Pass Filter
With this filter "in circuit" the response is 3dB down at 20Hz. Gets rid of rumble, and works very well with cinema noise reduction systems. Remove the filter and the response is flat to 0.5Hz.

Mono Input
Inserting a 1/4" phone plug into this jack disconnects the left and right stereo inputs and automatically bridges the amp for mono operation. No switches. No jumpers. No headaches.

THE P50 PROFESSIONAL 70 WATT PER CHANNEL POWER AMP

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three seminars was held aimed at dealers. These were under the umbrella title of NAVA Dealer Management Seminars. The subjects covered were Computers and Their Applications in an AV Business, Time Management, and Knowledge of Freight Can Increase Profits.

The fourth and fifth days included the Association of Audio-Visual Technicians Conference. Subjects covered included, among others, slide graphics and digital electronics.

The NAVA Professional Development Seminars picked up again on the fourth day to cover such subjects as Service Management—A Profit Center, Overcoming Sales Objections, Covering Your Territory in the 1980's, and Multi-Image Systems Selling.

The last day, the Association of Audio-Visual Technicians covered the subject of acoustics, noise control, and sound system design.

Other conferences that took place during the convention included the Association For Multi-Image, the Georgia Association For Instructional Technology Conference, the Health Education Media Association, and the International Television Association. Church Media '80 held its 10th Annual Religious Conference and covered such topics as TV Broadcast Production, Video in Religious Education, Cablevision, Electronic Data Processing, Graphics and Overhead Projection, and Multi-Image Presentations. AV is big business in all fields.

On the fourth day, the AV exhibits opened and remained available for visiting for the next two days. It would be impossible to even list the exhibitors within the limits of this column, but here is a quick alphabetical look at some of them, picked only to show the types and depth of the exhibits and the material and equipment displayed.

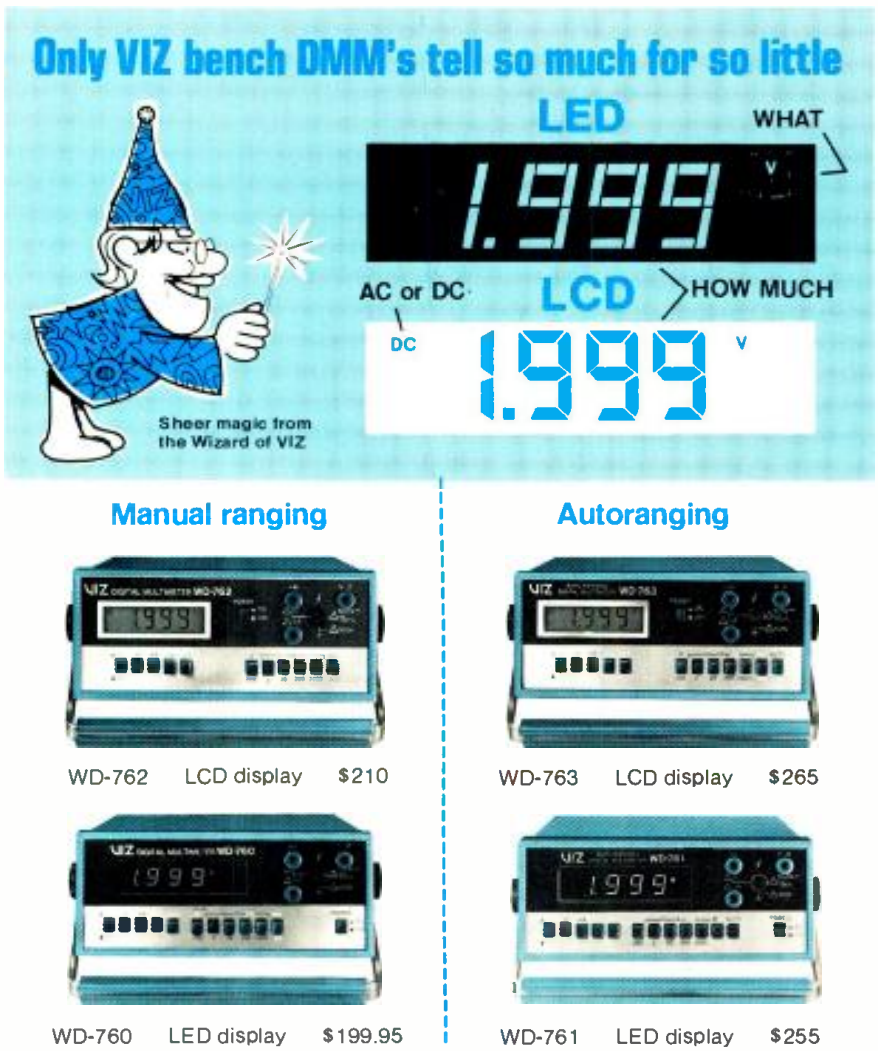
Arion showed its multi-image programming and presentation systems; Armstrong Productions had a slide reversing device; Audiotronics displayed audio equipment and multi-media kits; Audio Visual Laboratories put on a show with their multi-image programming equipment and showed their new Raven film control device; Audio Visual Workshop showed an automatic lamp changer for the slide projector; Avcom had overhead projector supplies and materials; William Bal Corp. handled custom carrying, shipping, and storage cases for AV equipment; Berkey Colortran, Inc. displayed portable lighting equipment for field and studio use; Byers Photo Equipment Co. displayed 35mm slide mounters; CNA Insurance discussed NAVA-sponsored business insurance; Chyron Corp. displayed a ¾" cassette cleaner and evaluator; and Classroom World Productions Inc. exhibited multi-media AV programs.

DISPLAYS AND PRESENTATIONS

Bill Daniels Co. showed Dealer and O.E.M. catalogues and the Illustrated Trade Reference Catalogue; Daystar Audio Visual Inc. showed rear projection screen viewers, random access projection equipment and slide dissolve equipment; DeWolfe Music Library presented production music and sound effects libraries for AV use with full copyright protection; Earmark Inc. had wireless learning systems, simultaneous translation systems, and hearing protection systems; Filmagic Products Inc. had silicone cloths, cleaning tapes, tape conditioner and lubricants; GE showed how Genigraphics made slides by computer; Hitachi showed TV cameras and monitors; and Impact Communications showed copy stands, slide duplicators, and dissolve/programmers.

The Jones Colad Group showed custom and standard AV packaging; Kaiser Products Corp. exhibited 2 x 2 glassless pin-registration slide mounts; Kimchuck showed their programmers and dissolvers; Lexicon displayed speech time compression/expansion equipment; and Mackenzie Labs. had AV control and Xenon projection systems.

NAVA, the National Audio Visual Association, with offices in Fairfax, VA, sponsors of the convention, had a booth



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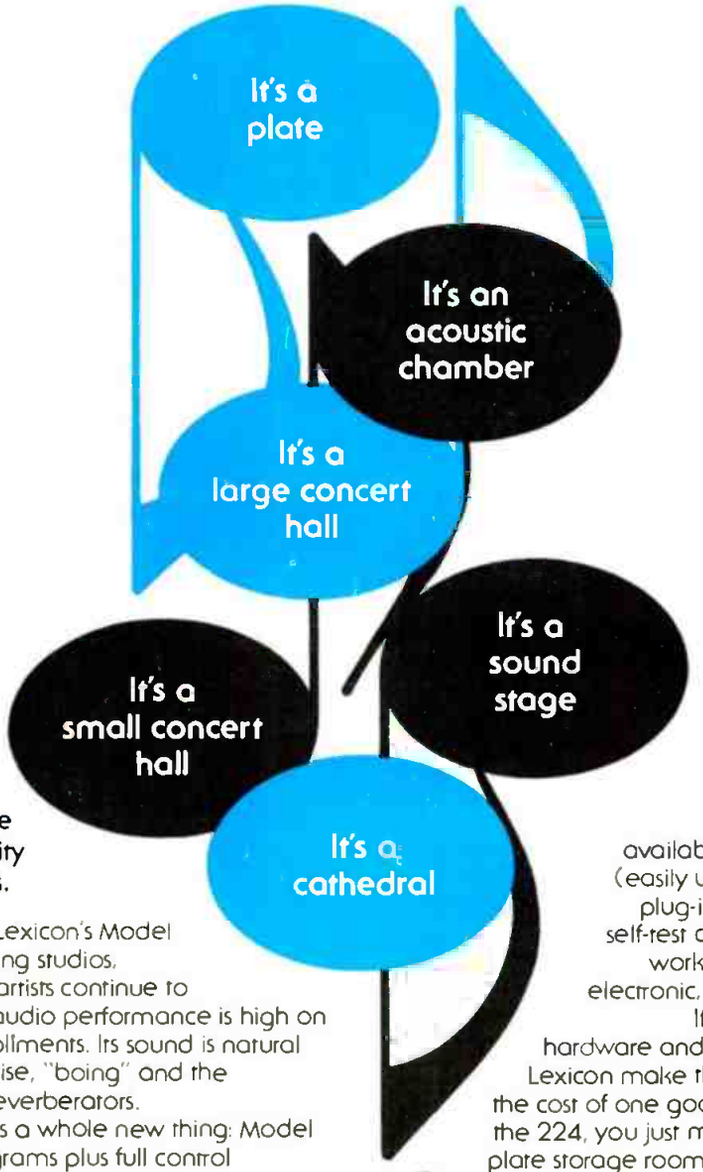

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in which they displayed their publications; Optical Radiation showed its high intensity Xenon programmable slide projectors; The Perf-Fix Co. exhibited a system for film perforation repair or preservation; Research Technology had automatic film inspection and cleaning equipment; Sanford Corp. showed its transparency pens and dry-erasable markers; Telescript presented its teleprompting systems; Visual Horizons had slide and filmstrip duplication to discuss as well as stock art slides and digital responder; and the H. Wilson Co. showed AV library furniture.

Everything from audio tapes and equipment through visual display devices were shown, including about 50 categories of hardware and software, somehow involved in audio visual or video work. It really was a BIG one. Plans are underway for next year's show which will be held Jan. 14-19 in Dallas. Then in 1982, the convention moves to Anaheim, California; in 1983 to New Orleans; in 1984 back to Dallas; in 1985 back to Anaheim; the 1986 location is still to be announced; and in 1987 back to Atlanta where the 1980 one was held. With the way the AV field is growing, you can't keep up unless you attend at least one of them.

Now that we've told you about conventions that have passed, here's one that is still coming up, and we urge you not to miss it. It is called Visual Communications Congress (you've seen that name in this corner before).

It takes place this month from the 28th to the 30th, at the New York Hilton. There will be 80 seminar/workshops that will cover in depth virtually every area of interest to those in the communications field. Some of the topics include photography, video, motion pictures, audio visuals, and the business and financial management of organizations working in these fields.

There will also be four technical free-for-alls, two in photography, one in video, and one in audio visuals. Representatives of the various equipment manufacturers in these fields will be there to answer any questions you may have.

More than 200 suppliers will be exhibiting and demonstrating their latest equipment, products and services. Among them will be Ampex, Arion, Arriflex, AVL, Audio Visual Workshop, Clear Light, Convergence Corp., Crestron, Devlin, Dukane, Electrosonics, Forox, Hitachi, and Image Transform. Also, Incredible Slidemakers, JVC, Mast, Oxberry, Producers Videocenter, Slide-Magic Systems, Spindler & Sauppe, Staging Techniques, Visual Graphics, and Xetron. This is where you will see it all.

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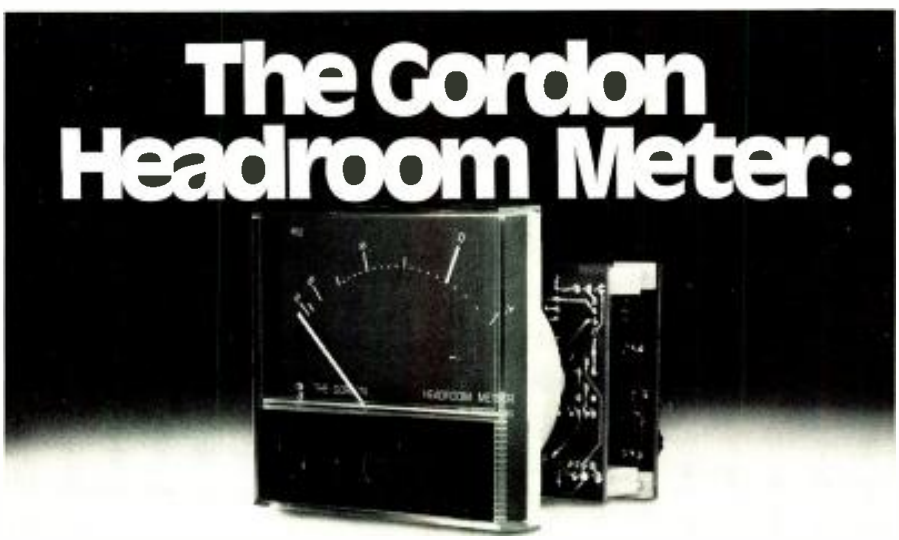

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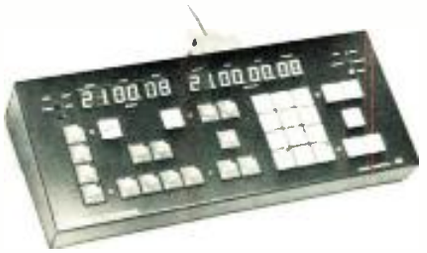

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Mfr: Countryman Associates
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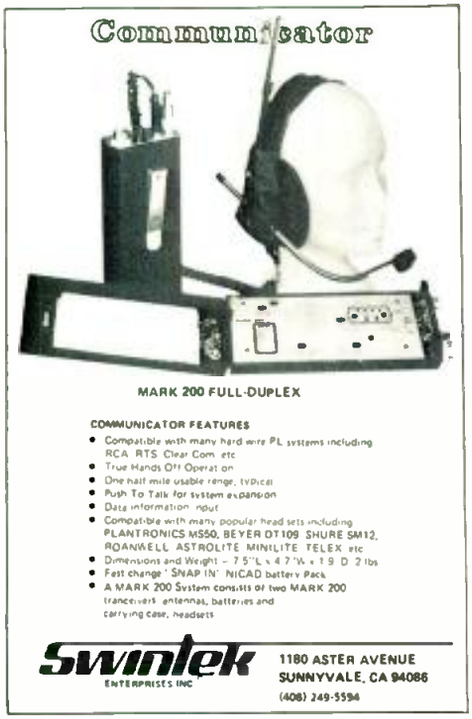

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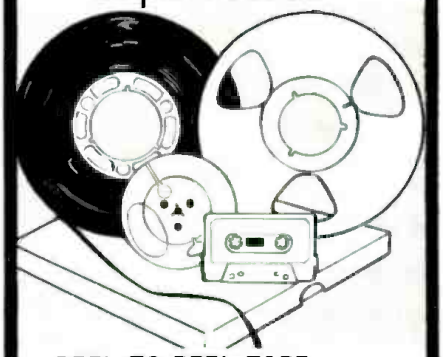

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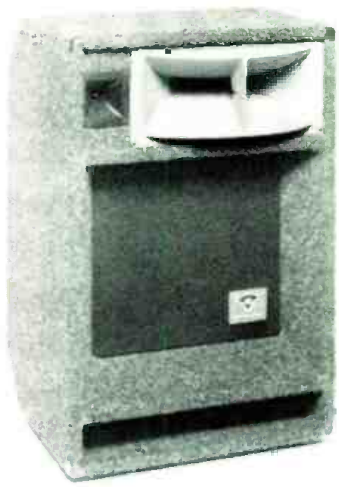

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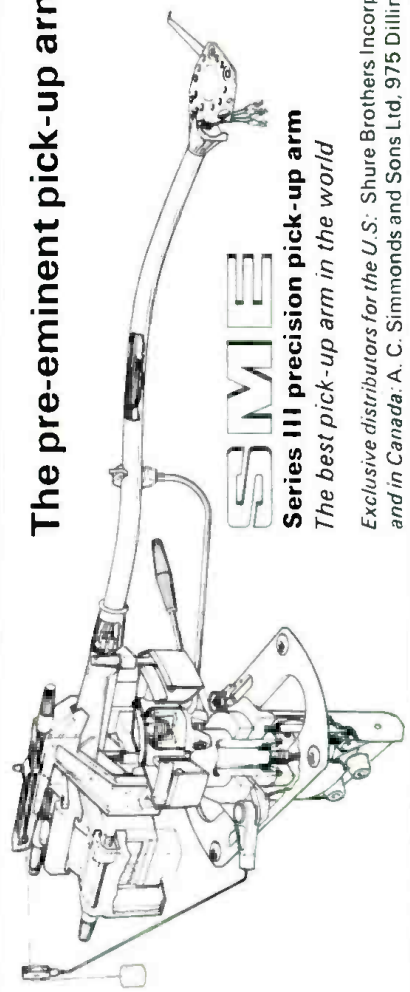

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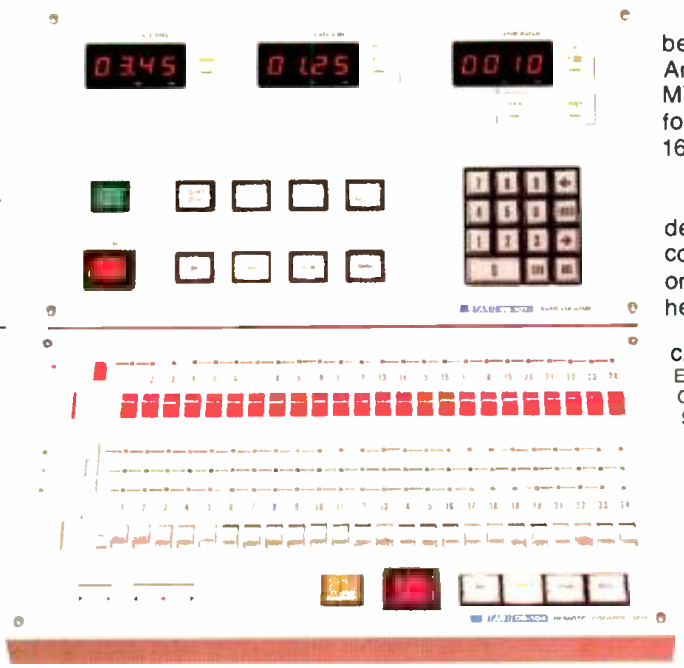

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db Editorial

Music City, USA

TOURISTS VISITING Nashville are often jolted by their first encounter with the Grand Ole Opry House. Ultra-sophisticated New Yorkers, as well as others in the international jet set, have often shown up expecting to discover a quaint little theayter—no doubt with Minnie Pearl romping across a creaking-timber stage.

Well, Minnie Pearl may still be around, but that sure ain't no timber stage anymore! Some years ago, the opry moved into its new home, which is grand allright, but certainly not ole' anymore. For instance, audio is now handled by a quaint little 40 input, $100,000 Neve board, and there's a fully-equipped TV production studio on the premises.

In short, times are changing—oops, *have* changed, down in Music City, USA. Of course, country music is still king, but everything else is also doing just fine, thank you. In fact, Nashville now has more studios-per-capita than even Hollywood!

What does this mean to the recording industry? Just that Nashville is no longer some far-off place where a few musicians come *from*—now, it's the place where most musicians go *to*—or wish they did!

Never one to ignore a good thing forever, we sent our man Sam (associate editor Zambuto, that is) to Nashville to spend a day or so looking for a story. He spent a week, and found four of them. Well, why not? We've been ignoring Nashville for some time now, and even four stories won't tell the whole story. In the future, we'll keep a closer eye on Music City, and suggest that you do too. There's a lot happening there, and we'd hate to miss out on any of it. Next time though, we'll go ourselves —after all, why should Sam have all the fun?

Since this issue of **db** gets extra distribution at the NAB (National Association of Broadcasters) convention in Las Vegas (April 13-16), we asked Len Feldman to have a look at what's in store for broadcasting over the next year. As we've noted so often in the past, the future good health of the recording industry is closely intertwined with that of the broadcast industry. And the broadcast industry is of course regulated by the FCC. And the FCC is not one of your faster-moving government agencies. And then, there's the NTIA (unfortunately).

What's all this got to do with recording? Well, although neither of these bungling bureaurocracies have figured out a way to regulate recording (yet), they certainly have a talent for making life hell for the broadcaster. And, as Feldman points out, the NTIA has some rather strange ideas about the realities of the world of radio and records, which the FCC actually seems to take seriously. Without the application of a little common sense, the efforts of the FCC/NTIA could very well take all of us back to the wonderful world of 1950 fidelity. In any case, Feldman's report brings us up-to-date on the future prospects for broadcasting—and that really means, for all of us.

Finally, we conclude with a look at Thevenin's Theorem, in which author Almon Clegg reviews how to simplify some otherwise-tedious design-and-interface problems. Thevenin's Theorem may not be tripping on the tongue of every recording engineer, and so this little refresher course may help some of us (your editor, at least) figure out what to do when there are too many components in the schematic.

A POSTSCRIPT ON D/λ

As we noted in our January, 1980 editorial, there's a slight difference of opinion on what sort of pressure increase occurs when a microphone is placed in a sound field. Theoretically, the pressure increase at the microphone diaphragm should reach maximum when the wavelength equals the microphone diameter. As usual however, there is often a discrepancy between theory and practice. Author Philip White quoted the theoretical case, while Ed Long reported on his practical experiences. See their January articles for more details.

The "textbooks" seem to support White, thus contradicting Ed Long's actual in-the-field observations. As a result, Long has written to report that he is busy assembling some data which "...will show the discrepancy between the response of practical microphones and the theoretical response." More on this in a later issue. In the meantime though, our thanks to all who took us up on our free-subscription offer. No, we weren't fooling. Winners will be notified shortly. All you others, keep a lookout in future issues. The response was so good, we're surely going to try this again some time. When? You tell us! ■

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SAM ZAMBUTO

The Nashville Sound Is Alive and Well

Long known as the country music capitol of the world, Nashville is broadening its musical horizons, and gaining recognition as a true recording center for all *types of music.*

THE RECORDING INDUSTRY in Nashville is buzzing, and—as one may well imagine—lots of country music tracks are being cut. In fact, ninety percent of all country music recorded in the United States is cut in Nashville. But that's only one facet of the much broader, often obscure, musical picture that goes to make up "Nashville —Music City, USA."

Walk into any Nashville studio today, and one thing is for certain—they're not just playin' country music. A little pop here, some R & B there, perhaps even a little jazz down the block—whatever the musical idiom may be—the word is out: Nashville studios and musicians aren't just producing the best *country music* around, they are producing some of the best damn *music* around.

But it's hardly a new phenomenon: Nashville was cutting pop tracks in the late '50s and early '60s—termed, at the time, "progressive country," "cosmopolitan country," and/or "Rock-A-Billy." (Go back and listen to some of those early Elvis Presley recordings, which came out of RCA-Nashville's Studio B.)

Country music has always been, and probably always will be, the mainstay in recorded music in Nashville. The respect for country music will never dwindle, because country music was the beginning for Nashville as a "music center"—its heritage—and every effort is made to keep country music a vital and vibrant part of the music industry. To that end, the Country Music Association, headquartered in Nashville, has been greatly responsible for the phenomenal growth of country music; not only in the United States, but overseas, as well.

PUSH ON POP

Over the past few years, Nashville studios have been aggressively seeking, and obtaining, larger portions of the pop-music pie. The influx of musicians from other parts of the country (Miami, Los Angeles, New York) has diversified the Nashville music industry. Yes, of course you can still get the "Nashville Sound" for that country-sounding jingle; but you can also get more than that too!

At first, producers were drawn to Nashville for the country sound, now they come to cut anything from funky R & B, to slick pop, to down-home country. The story is told, time and time again; an out-of-town producer calls, saying: "I've got a number of jingles to cut. I'll be down early next week to do the 'country' version." The complaint coming out of Nashville is: "Why not cut 'em all here?" And the trend in recent years is moving in just that direction; producers are finally giving the Nashville studios a "shot" at other musical idioms, and they're returning home, much to their delight, with handfuls of great recordings. On record dates as well, producers, whether they be "outside" or "home-town," are searching for that "crossover"—a pop record with that country feel.

Approximately one-fifth of the 120 commercial recording studios located in Nashville cut the bulk of the record dates. (Nashville has more multi-track recording studios per capita than any other city in the world.) Since a fair percentage of Nashville recording studios are owned by entertainers, publishing companies, and/or commercial production houses, the studio structure is not based on a rental system, in terms of booking studio time. For example, one Nashville studio, the Soundshop Inc., is owned and operated in-part by Soundshop Productions, a jingle production company. Approximately 50 percent of the Soundshop's studio bookings (jingle recording) is generated by Soundshop Productions; the remaining studio time is left for "outside" production, to be booked on a rental basis.

THE NASHVILLE SOUND

Ask twenty different people in the Nashville music industry (be they producers, engineers, or musicians) "What is the Nashville Sound?" and you are likely to get twenty different answers. Many however, maintain that the Nashville Sound is something that developed with the first group of musicians who started to play sessions in Nashville's recording studios. They played together so long that they became atuned to one another, they sensed each other's moves. And, as a result, it freed the musicians to concentrate more on the *feel* and *emotion* of the music. To that extent, the Nashville Sound is typified by a very tight, solid rhythm group, which plays with an enormous amount of feel. Serving the area well, this stylized, distinctive sound has been Nashville's trademark since the birth of its recording industry.

In earlier times, the Nashville sound was largely characterized by that laid-back feeling in the rhythm section—a high-third rhythm guitar in tight combination with the bass, drums and piano. Over the years, the laid-back feeling has remained an integral part of the Nashville Sound (always just on the "backside" of the beat), however, there has been an increasing awareness of the influence of modern pop. And there now exists a growing number of local music industry people who would like to get out from under the "stigma" that the Nashville Sound has created; to branch out into other facets of

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the music industry, making Nashville a *true* recording center. But certainly, the Nashville Sound is still alive and quite well—no doubt changing, adjusting and refining with the times.

RECORDING IN NASHVILLE

Nashville has always been a magnet, attracting a wealth of talent in the form of songwriters and musicians. Although Nashville supports just under 2500 union musicians (very little non-union work is to be found in Nashville), there are a select-few "mainline" players who work four sessions a day, six days a week. Standard union scheduling calls for three-hour recording sessions, beginning at 10 am, 2 pm, 6 pm, and 10 pm. In line with the American Federation of Musicians' national scale, session men earn between $90.00 and $120.00 for the three-hour session. Since recording sessions usually run "three hours on, one hour off," in order to block-book studio time, one asks for a "10-2-6-10."

The attitude of the Nashville musician is generally very relaxed, productive and constructive. Due to the trust and confidence that exists between the Nashville musicians, there is a freedom and willingness to offer suggestions during a session. Very often, the musicians play the sessions without arrangements; utilizing a unique number notation system, rather than playing by notes. While most of the Nashville players are well-able to work from charts, the number system expediates the process of putting a song together.

HOW THE SYSTEM WORKS

At the recording session, the artist or producer will play the song once-through, singing the melody. The musicians, using their number notation system, write down the melody line of the song. A song can be written in about 5 or 6 lines of numbers, with each individual musician employing his own style of notation for repeats, codas, and letter A's. The system lends itself to a free-style form of playing, where the musician is going more for the feel. Each musician is his own producer—given the mainframe of the song, he is allowed the creative freedom to add or embellish as he sees fit. It's difficult to do a session in Nashville without a lead singer, since the musicians play to the lyric—enhancing the lyric content, rather than an instrument track. In Nashville it's all *feeling*.

Many out-of-town producers have literally torn up their arrangements, often making the comment that the musicians have developed a better concept of the song than what was written on the charts.

THE PLAYERS

Within the Nashville community of musicians, there are

Rock and Roll Hotel

Studio Instrument Rentals, with offices in New York, Chicago, Los Angeles, San Francisco, Nashville and London, provides rehearsal studios, equipment and cartage services primarily to touring bands. However, the Nashville branch, opened by Steve Bauer in 1978, offers one more service—a hotel, "Close Quarters," which caters to musicians, in particular, and the music industry, in general.

Established originally to accommodate touring bands, a full one-third of their business has been realized through the housing of recording bands that come to Nashville to cut tracks for their latest album project. With the increase in pop-music recording in Nashville, Close Quarters has found recording studio people to be a growing segment of their clientele.

The "Rock and Roll Hotel," as it is affectionately called, offers music industry people: twenty-four hour bar and room service; saunas on every floor; suites, as opposed to a room with four walls; limousine service twenty-four hours a day; and rooms furnished with stereo systems and keyboards (one suite even has a *Baby Grand*). Certainly unique to Nashville, Close Quarters is the only hotel in the country that specifically caters to the music industry—where else but Music City, USA?

Diversifying to some extent, Close Quarters has opened its doors to those in the television and film industry as well. Of late, there appears to be a scurry toward film production in Nashville—no-doubt inspired by the State of Tennessee's active pursuit of the movie industry.

In addition, Close Quarters operates a private club, called "The Backstage Pass." Closed to the general public, The Backstage Pass Lounge is available only to hotel guests and a club membership of some 500 Nashville music-industry-related people. It allows the visiting musicians to relax in comfortable surroundings removed from the mainstream.

Why choose Nashville to implement such a unique concept? According to Steve Bauer, manager of the hotel, the difference in real estate and construction costs was substantial between Nashville and other possible areas of consideration (Los Angeles and New York). Nashville was simply a more-feasible locale, financially. Couple that with the fact that Nashville, in general, is a very "poor service" town, and one quickly realizes that the market was ready, if not begging, for a "Rock and Roll Hotel." ■

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players who are geared to cutting pop-music, hit records; there are players who are geared to cutting commercials; and players who are geared to straight-ahead country sessions. And, along that whole continuum exists variations in musicians ranging from the very strict, technical, regimented type of player, with very little "feel," to, on the other hand, the very heart-felt, play-what-you-feel type players. The characteristic "sound" for a particular session is often defined by the extent to which an engineer or producer—with a working knowledge of Nashville musicians and where they fit along that continuum—can select and combine various types of musicians.

The engineer in the Nashville recording studio plays a commanding role in shaping the Nashville Sound. An engineer has the same involvement, start-to-finish, in a particular project, as the artist, players or producer. Since there is only a very small amount of freelance engineering in Nashville (although that trend seems to be changing) almost all engineers are committed to working at "a studio." As a result, the engineer tends to be as concerned about the studio's success or failure, or the condition of the equipment in the facility as are the owners.

Making a record in Nashville is a unison effort between the artist, producer, engineer, and musician.

STUDIO ACTIVITY

Studio time, on the average, runs $130.00/hr. and is all-inclusive—studio, engineer, outboard gear, musical instruments, etc. Throughout most of Nashville's recording studios, the studio is set-up before the musicians ever arrive—mics in position, headphones laid-out—rather than having the musicians walk into an empty room. Everything is done, in such a way, to reduce any possible tension or unnecessary pressure.

Typically, there is never any rush to get the session started—a 10 am date might easily start at 10:30. But once the session does get underway, it is generally very productive and efficient. (It's not to be taken, however, that a session can't be interrupted, as it often is, for a musician to stop and tell everyone a joke.)

"Laid-Back" seems to be the key word when describing the Nashville music industry—laid-back but efficient. Because of the relaxed atmosphere typical of a Nashville recording session, there exists a climate for teamwork and good relationships between the engineers, producers and musicians. Many of the Nashville music industry people are quite adamant when they point out that the laid-back, comfortable feeling is reflected in the music coming out of Nashville.

Nashville studios, like studios in any recording center, are looking to put out the best product they possibly can. ■

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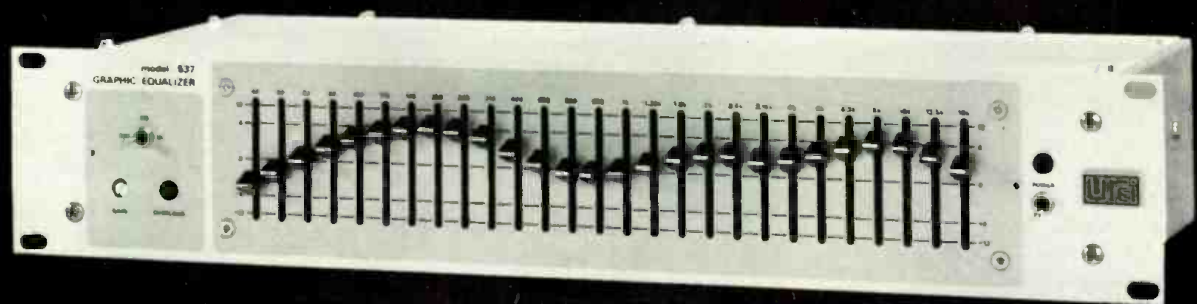

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SAM ZAMBUTO

db Visits: The Grand Ole Opry

Home of the Grand Ole Opry, the Opry House wears many hats—serving as a broadcast, recording and teleproduction facility.

WITH A HIGH CONCENTRATION of colleges and universities, and a fair amount of ancient-Greece-influenced architecture scattered about town—a replica of the famous Athenian temple, The Parthenon, stands in the Centennial Park—Nashville is often referred to as the "Athens of the South." Overshadowing much of what goes on in Nashville, The Grand Ole Opry, broadcast each week over WSM, has become a living legend—the "Mecca" of country music in the U.S., as well as overseas. Drawing over 900,000 people annually, the Grand Ole Opry and the city of Nashville have continued to flourish and grow as the "home of country music." (Many Nashvillians, while proud of their country music heritage, are quick to point out that Nashville is the home of a fine symphony orchestra.)

For the third consecutive year now, the PBS Television Network has broadcast, live, coast-to-coast, a three-hour Grand Ole Opry performance. On such occasions, the PBS Television Network is invited in as an "observer." There is no special staging of the Opry performance to suit the television broadcast; therefore, the television viewers see the Opry in much the same way as someone attending the performance.

International in scope and appeal—country music is growing in popularity by leaps and bounds overseas—The Grand Ole Opry will be broadcast, April 26, 1980, over Radio Luxembourg in Germany, with an estimated listening audience, throughout Europe, of well-over four million.

HUMBLE BEGINNINGS

It all began, over a half-century ago, with the first broadcast of the "WSM Barn Dance" back in November 28, 1925—two years later the name was changed to "The Grand Ole Opry." (Three of WSM's engineers were responsible for the construction and operation of the Castle Recording Studio, Nashville's first recording studio.) When the WSM Barn Dance began, it was strictly a radio broadcast produced out of WSM's studios. As time passed, more and more listeners came down to the studio to peer through the studio window and catch a glimpse of their favorite country-music personalities. At that point, the National Life and Accident Insurance Company—the parent company of the 50,000 watt, clear-channel station—decided to build a facility, Studio C, to seat a few hundred people, and thereby incorporate their reactions into the program.

In short time, the studio could no longer accommodate the crowds and The Grand Ole Opry was moved to the Hillsboro

Outside view of the Grand Ole Opry.

Sam Zambuto is Associate Editor of db Magazine.

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Opryland Productions' Video Master Control.

Theatre, a former movie house in the southwestern part of the city. Continued audience growth necessitated another relocation of the Opry to a huge tabernacle, across the Cumberland River. In 1939, the show was moved to the newly-constructed War Memorial Auditorium, where an entrance fee of twenty-five cents was levied in an effort to limit the crowd—weekly Opry audience attendance, at this point, averaged better than 3,000. Forced by the ever-increasing audience demand, the Opry, once again, relocated in 1943; this time to the Ryman Auditorium.

HOME SWEET HOME

In 1974, The Grand Ole Opry moved, presumably for the last time, to its present $15 million dollar home at the Opryland USA complex—the first house specifically built for the Opry. While the Opry House stands as the focal point of the 400-acre complex, the large, sprawling Opryland Park provides live musical shows, natural animal habitat areas, rides and restaurants. The Opryland Hotel, Tennessee's largest hotel-convention-exhibition center, is located directly adjacent to the Opryland Park.

OPRYLAND PRODUCTIONS

The Opry House, in addition to being the home of The Grand Ole Opry, also houses Opryland Productions in the rear of the facility. Operating as a complete teleproduction facility, Opryland Productions maintains a large, fully-equipped television studio, with a live-audience seating capacity of 300.

Opryland Productions' custom-built Cetec audio mixing console.

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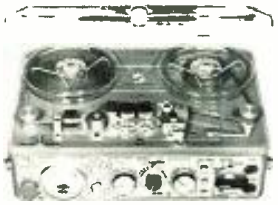

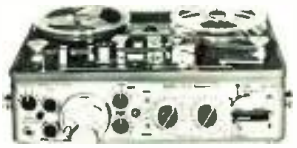

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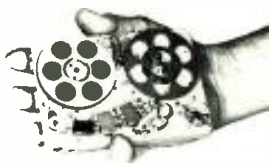

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Inside, the show goes on....

Opryland Productions provides in-house prop and set design, construction and storage facilities.

The television studio utilizes a custom Cetec mixing console and Ampex 2-, 4-, and 16-track tape machines. The video facilities are equipped with two-inch, quad and one-inch, helical-scan VTRs, and the CMX-300 video editing system. Meeting the large-volume demand or remote video services, Opryland Productions operates four, fully-equipped, mobile video vans—complete with RCA TK-76 cameras and Sony one-inch helical-scan VTRs.

The Country Music Awards show is broadcast live, each year, from The Grand Ole Opry, using the Opryland Production facilities.

THE GRAND OLE OPRY HOUSE

Fully air-conditioned, unlike the old Ryman Auditorium, The Grand Ole Opry House seats 4,400. Sound design engineer Richard Negus, of the architectural acoustics consulting firm Purcell & Noppe & Associates, Inc., designed and supervised the implementation of the audio system for the Opry house. Installation services were rendered by a local, Nashville-based P.A. company—Allied Sound (later renamed: Technical Industries).

All of the house sound for the Opry radiates from a single speaker-cluster suspended above and in front of the stage; except under the balcony, where a very low-level distributed-sound system (on a digital delay to match the sound arriving from the cluster) is employed to enhance the midrange. The cluster, powered with Dukane amplifiers, consists of Dukane horns and high-frequency drivers coupled with a JBL low-end. Generally this system has served the Opry well, since Grand Ole Opry performances usually don't require the excessive sound levels that might be found in a rock-type concert performance. However, the system does display some weakness in terms of the maximum sound level achievable. In an effort to provide that extra capability, several revisions in the cluster design are planned. These revisions include: changing all the high-frequency drivers over to JBL 2441s, and relocating the power amplifiers to reduce cable runs, thereby increasing the damping factor and hopefully achieving a tighter bass sound.

MICROPHONE DISTRIBUTION SYSTEM

The stage set-up of the Opry—a unique design at the time—employs a microphone distribution system whereby the microphone signal is routed to the input of a distribution amplifier (DA), receives 20 dB of gain, and is distributed to four different consoles in four different locations—the television studio console, the radio broadcast console, the house P.A. console and the stage-monitor or foldback console. Utilizing 40 custom-made Bushnell microphone DAs, the microphone distribution system allows four totally independent mixes of 40 different microphones.

A specially-manufactured Belden microphone cable, designated "Star Quad," is used for all stage wires carrying microphone-level signals. The Star Quad cable, designed by the B.B.C., is constructed with a center conductor (used only as a spiral former) around which four conductors plus a string filler are spiral-wrapped, then there's a foil-wrap and a spiral-wrapped tinned-copper shield.

The cable displays a high degree of resistance to electromagnetic induction and low and high-frequency (rf) interference; providing up to 20 dB common-mode rejection.

While the Opry house is free from rf problems—the entire structure (floors, walls and ceiling) contains a special 2 x 2-inch welded wire mesh which provides virtually 100 percent rf rejection—the Star Quad cable is highly beneficial when strung along the stage with light cables carrying SCR control voltages.

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Therefore the Star Quad cable is used solely for making stage snakes and mic cables—Belden 8451 cable is used for lines in conduit throughout the building. (For more information on the subject, see **Audio Cable: The Neglected Component,** in the December, 1978 issue of **db.**—Ed.)

MICROPHONES

Originally, four super-cardioid microphones were predominantly used in the Opry—the house was tuned for minimum-feedback, but musicians complained about a lack of bottom, and handling noise became a technical problem. Of late, the Opry has realized a slight improvement with the application of Shure SM58s. With the close monitoring set-up employed on stage, there has been more success with gain-before-feedback using the SM58s.

The Opry utilizes a variety of microphones—AKG 451s, RCA 77s, E-V RE-16s and RE-20s, Shure SM81s and SM58s, Sony ECM 50s, Neumann U-87s, and both the Vega and HME wireless systems. Permanently mounted on the rim of the balcony are two antenna systems which are connected to related receiving and matrixing gear capable of handling as many as eight wireless systems in the 160 to 220 MHz range. There are approximately 20 RE-16s located throughout the house for audience pickup. (There is an ongoing process of placing, evaluating and relocating these mics to get the best possible audience pickup, while maintaining the greatest amount of P.A. rejection).

Instrument amplifiers are supplied to the Opry by the various manufacturers—Fender, Peavy, Show-Bud, etc. The Opry keeps these amplifiers in stock, and musicians use the amps they prefer.

FOLDBACK SYSTEM

The stage monitoring or foldback system, a 40-input, four output mixing console, was chosen for its cost-effectiveness and flexibility. The console is made-up of Shure 101 and 110 mixers, with Shure one-octave 107 equalizers on all output channels—one-third-octave equalization is also available on two of the output channels. The original stage monitoring system employed a single horn mounted on the rear of the house speaker-cluster, however, due to the delay, that system never proved satisfactory. Electing to go the route of close-monitoring, the Opry currently uses stage-mounted monitor boxes driven with eight different power amps—four of which operate at 8 ohms for the higher-powered, better-quality speakers; and four of which operate at 70V for small speakers and earphones. The 70V monitoring system is distributed on mic lines with three-pin connectors (wired backwards from the microphones to prevent costly mistakes with the normal mic circuits). Any of the four outputs of the foldback console can be routed to either of the two systems of foldback amplifiers.

HOUSE P.A.

Feeding the house speakers is a 20-input, two channel custom-built (Spectra Sonic active modules with Audio Design Slidex attenuators) audio mixing console. Because of the limited number of inputs, supplemental auxiliary mixers have been added. Upgrading the house P.A. system, a 40-input Midas TR Series theatre console is on order, and is expected to be in full use by mid-May, 1980.

RADIO PROGRAM CONSOLE

Outfitted with a '74-vintage custom Neve 40-input mixing console, the master audio control room for the Opry house assumes studio control for WSM radio during the broadcast of the Grand Ole Opry—playing the commercials and keeping the broadcast logs. (The transmitter, not on remote control, is manned at all times).

The console features 16 mix buses, 16 monitor channels, quad and stereo mixdown sections (the mono output is a direct

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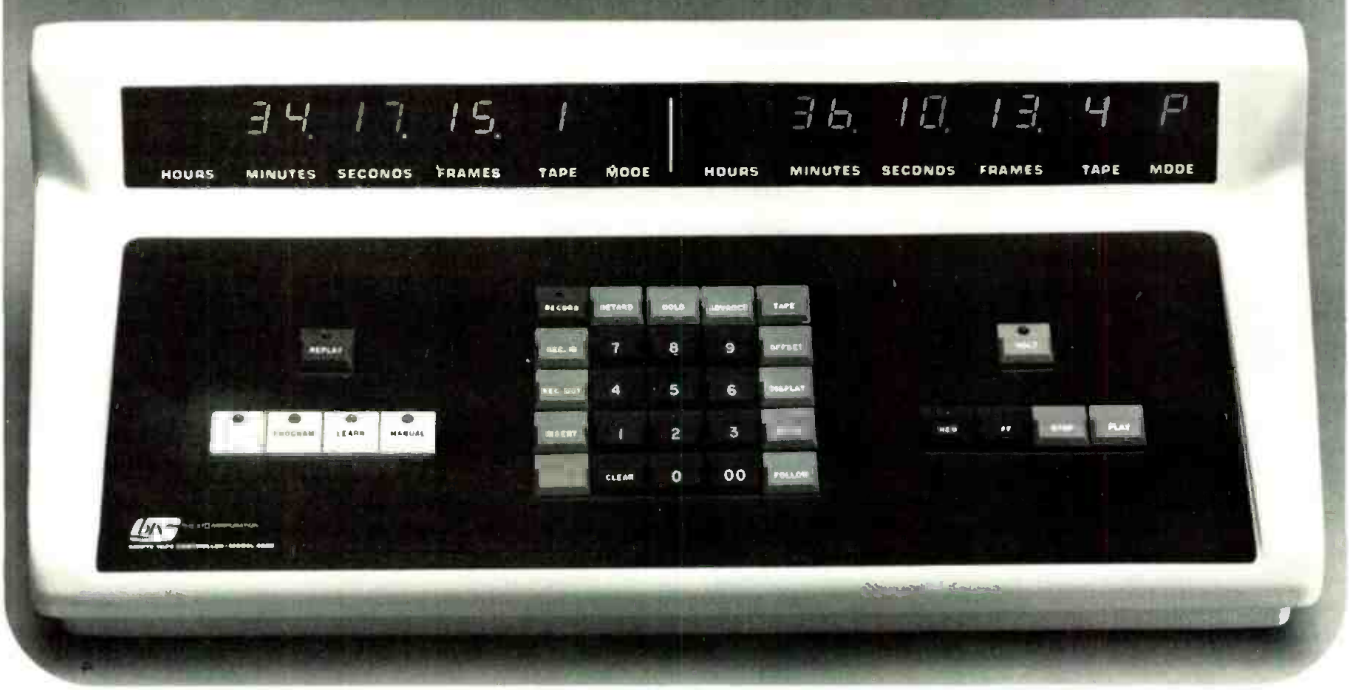

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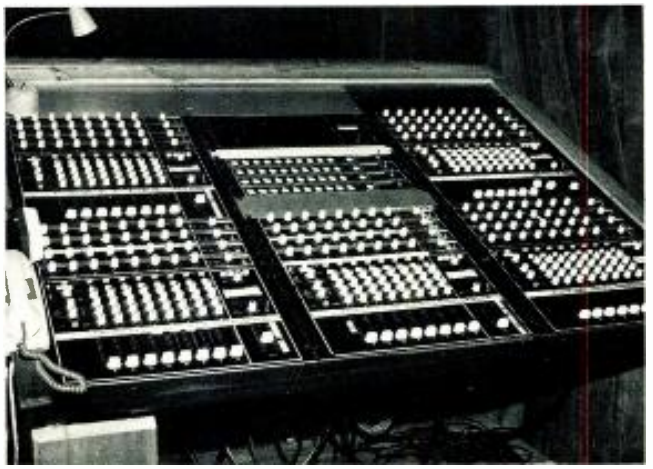
Ampex 2-, 4-, and 16-track tape machines are used in Opryland Productions' television studio operation.



The foldback console used for stage monitoring in the Opry House.

four-to-one mix of the quad), four echo sends and returns, and four cue sends with individual adjustments (originally each module had four push buttons with one control for the cue system, that was later modified to four individual controls).

Alongside the Neve is the Opry's old foldback console, a 16-input board now used for a pre-set 16 x 1 mix of the audience-pickup microphones. The control room is also equipped with two 2-track and one 16-track Ampex tape machines. Seldom used, the 16-track is pressed into operation whenever a Grand Ole Opry performance is being video-taped—in such instances, the 16-track is rolled as a protection for re-mix. Monitors in the control room are JBL 4320s.

The link transmitter located in the Opry house, transmits the program to the WSM studios, where it is routed directly to the primary tv-FM transmitter operation which transmits the program via another link to the AM transmitter.

Also included in the Opry's facilities are a projection booth (for occasional slide or film inserts into the program) and the main lighting control booth—the console of which utilizes a diode-matrix assignment.

OPRY ROOM RESPONSE

The bench-type seats (a hold-over from the Ryman Auditorium) are covered with a carpeted-type padding which was specifically designed to provide the same degree of sound-frequency absorption as a fully-occupied house. In other words, the frequency response of the room should—and more or less does—remain the same, regardless of the number of people in the house.

The Neve 40-input custom mixing console used in the broadcast of the Grand Ole Opry over WSM Radio.

As far as the acoustical environment of the Opry House is concerned, there are no plans for major alterations. Of course, when the new P.A. console and horn drivers are installed, there may be some slight modifications necessary; such as re-aiming the horns in the speaker cluster.

The Opry House has much to be proud of, with regard to its sound system. Hugh Hickerson, chief engineer of the Opry House, feels that there are some aspects of the system where improvements are needed—many of which, as mentioned earlier, are currently in the working or under consideration. In the future, Hickerson looks to "substantial improvements, particularly in the area of reliability and operation flexibility."

THE FLOOD

In March of 1975, on the eve of the first-anniversary celebration of The Grand Ole Opry's move to the Opryland facility, the Cumberland River over-flowed its banks—the result of a tremendous down-pour—totally flooding Opryland Park. Water came pouring through several of the conduits serving the Opry House, filling the entire basement area to within eight inches of stage level. Conduits throughout the building, to this day, are packed with river mud. Fish and snakes were left behind, in the Opry House, as the water drained.

As a result, the following evening the Grand Ole Opry celebrated its first "Opryland" anniversary broadcasting from the Memorial Hall in downtown Nashville; playing before the largest Opry attendance (some 6,000 people) ever recorded. Relatively little damage was sustained by the Opry House, but the event imposed an enormous clean-up campaign. The Opry was back in its elegant surroundings in time for the following week's performances.

THOROUGHLY-MODERN OPRY?

The Opry, by tradition, has always been extremely informal, presenting the illusion that the show is "just coming together" as the performers appear in a steady stream on stage. The Opry, since coming to its "new house" in 1974, has continued to maintain much of the original flavor that endeared many to it. Of course, there have been some changes also—a more-modern appearance, for one. When the Grand Ole Opry was housed at the Ryman Auditorium there was only a snare drum on stage—that due, in-part, to the space limitations of the stage—now there is a full drum set employed.

The Grand Ole Opry has never been a trend setter. It's been a slow evolution, but the Opry has been changing with the times—moving to the new house in 1974 was a major step in that direction. ■

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SAM ZAMBUTO

Nashville Studios Shift to High Gear

The mood in Nashville today is state-of-the-art and "how soon can I get it?".

BACK IN THE EARLY DAYS of multi-track recording, Nashville was an Ampex town. It was not uncommon to find 350s and 440s connected to four-bus Altec boards, or an occasional API console. Many of the other consoles came in kit form, and were wired by engineers of WSM and the Grand Ole Opry.

Since that time, tremendous technological advances have swept through Nashville studios, as they have across the country and around the world. Traditionally, however, the Nashville pro' recording community has been rather conservative. While Nashville studios have never taken a back seat in terms of technology, very often they have lagged slightly behind to carefully evaluate the benefits that the new technology has to offer. After all, it is no longer uncommon in the recording industry to slap-down a cool $100,000 on equipment that could conceivably become technologically obsolete within the short space of a year or two!

ONCE BITTEN, TWICE SHY

Perhaps it's the fear of being burnt in the technological race of the recording equipment world that has led Nashville studios to take up this wait-and-see attitude. Nashville studios, by and large, are not caught-up in the "must have the first one" syndrome—they would prefer to be a little more cautious and deliberate in making their equipment purchasing decisions. In other words, it's okay to have "number 10" in the production run.

Glenn Snoddy, president of Woodland Sound Studios, gave an interesting account about a piece of recording gear that Woodland was "first" in getting—and sorry they were. The item was a new 16-track tape machine. They saw it at an AES show, were impressed, and ordered one on the spot. They received "number 2" from the production-line run. There was just one slight problem with the machine—from the day it arrived, to the day it finally left, it never played a tape. At one point, the transport even blew-up in the face of the service technician sent to Woodland to make the thing work. From Woodland's point of view, the whole incident was a total disaster, resulting in the loss of valuable studio time.

Perhaps it was a combination of bad circumstances, but Woodland felt there was a lesson to be learned. Certainly, it has not interfered, in any way, with Woodland equipping its two, 24-track studios with top-notch, state-of-the-art gear—it has merely taught them to be a little more cautious in their equipment purchasing decisions. Both studios at Woodland are fitted with Neve consoles, Studer A-80 24-track tape machines and Westlake monitoring systems. As for automation, Woodland is currently evaluating several systems—trying to choose the best one for their needs. In addition, Woodland maintains two in-house mastering rooms for cutting lacquers—providing custom mastering services for many of the major record labels in Nashville, as well as cutting a number of direct-to-disc projects. (See Glenn Snoddy's feature on **Custom Mastering,** in the June, 1977 issue of **db**.)

FINANCIAL CONSIDERATIONS

Jim Williamson, general manager of Sound Emporium (formerly known as Jack Clement Recording Studios), theorized about the different financial considerations between Nashville and other recording centers, in terms of gearing-up the studio.

According to Jim, the majority of the sessions recorded in Nashville studios were, until recently, country dates, while Los Angeles and New York attracted the majority of pop sessions. Historically, the big-city budgets for pop sessions have been much greater than those allocated for country sessions. Nashville producers have just not had access to the big bucks reserved for Los Angeles or New York clients. Therefore, in the studio, they are in and out in short time—they don't spend much money, and they don't block-book for three or four months, as one sometimes finds in LA or NY. Couple to that the fact that Nashville studio rates, in the past, have not been as high as in other areas, although they have been required to equip their studios as well.

Needless to say, working under those financial constraints, Nashville studio owners have been, by necessity, cautious about the type and cost of equipment purchased. However, Jim was quick to point out, this caution usually excludes consoles and tape machines—Nashville has always gone first-class on this type of equipment.

At Sound Emporium the studios are equipped with Studer 2- and 24-track tape machines, Harrison 3232C consoles, JBL (studio A) and Westlake (studio B) control room monitoring, and an impressive array of signal processing units.

RESISTANCE TO NEW TECHNOLOGY

At first, the introduction of the 24-track tape recorder was met with a slight degree of resistance from some of the older generation of engineers who had moved up into studio management positions. But the realization soon came that they must move with the technology in order to remain competitive. Due to the increasing influx of pop music recording in Nashville, many artists and producers are now demanding all the "bells and whistles" that they see in other recording centers. As a result, the move to 24-track and automation is now readily accepted in Nashville.

Sam Zambuto is Associate Editor of db Magazine.

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Both Woodland's studios sport a Neve console—this one's in Studio A. The ADM 4 monitors (atop the console) are used in conjunction with the Westlake monitoring system (not shown).

A partial view of Studio A—the larger of Soundshop's two studios.

Woodland's disc mastering facility—equipped with Neumann's SAL 74 cutting system.

Complete with Harrison's 3232C console and Westlake's monitoring system is this control-room view of Studio B at Sound Emporium.

Travis Turk, chief engineer at The Soundshop, Inc., no longer sees a resistance to such moves in technology. The thinking in Nashville is now: "What would be the best move? Should we go 32-track single machine, or, dual-machine 48-track?"

The Soundshop, which has managed to diversify into many areas of recording (jingles, film tracks, tv commercial tracks, as well as record dates), maintains two 24-track studios equipped with MCI 500 Series automated consoles and MCI 24-track tape machines. Each studio has its own generous sprinkling of the latest in ddls, limiters, Dolby, dbx, etc. Studio A, originally built in 1971 and completely refurbished two years ago, is the larger of the two studios, and is capable of handling a sizeable number of musicians in live, straight-ahead recording sessions, or film tracks. Studio B, a John Storyk design, is used mostly as a tracking room.

The control room monitoring environment is a major source of attention in most Nashville studios; here, one is apt to find the very latest in design and innovation. Both control rooms at The Soundshop have been outfitted with Audicon monitors designed by Claude Hill and John Storyk, using JBL components.

The Soundshop houses the only floating room (Studio B) built in Nashville—considerations for going that route were based on the facility's close proximity to the Interstate Highway Loop.

DESIGN CRITERIA

Studio design in Nashville leans toward a "homey" feel—generally less "Star Trek" and more "rustic." By and large, the end result of Nashville studio design is for everyone involved in the recording session to feel comfortable, while at the same time maintaining a first-rate acoustical environment. Unlike New York studios, where certain technical requirements are the result of maintaining a studio in a large urban center (multi-level buildings, large volumes of street noise, subway rumble, etc.), practically all Nashville studios are located in a suburban environment.

LSI Sound Studio, Inc., like many of the high-quality, sophisticated studios in Nashville, is located on Music Row, in what was once a house. (At one time, Music Row was a very high-class residential section. Following the lead of Owen Bradley, who in 1955 set up the Quonset Hut Studio on Music Row, many music industry-related businesses—record labels, publishing companies, recording studios—began buying up the old houses, developing a heavy music industry concentration in the area.) With the exception of the outside shell, the entire house was redesigned and modified to develop an acoustic environment conducive to a recording studio—walls were knocked down and/or built as needed. While hindsight is always 20/20 vision, Kathleen Lewis, president of LSI, admits

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LSI Sound Studio featuring Harrison 4032 console. (Photo by Don Putnam)

Studio at LSI set-up for session. (Photo by D. Putnam)

that it may have been easier, and less expensive, to have started from the ground up.

LSI opened for business in November, 1973, originally as a 16-track facility. Since that time, LSI has upgraded to 24 tracks. The control room is equipped with a Harrison 4032 mixing console with Auto-Set automation, an MCI 24-track recorder, and a Studer A-80 2-track machine. In addition, the studio maintains a full complement of outboard gear—ddls, compressor/limiters, dbx noise reduction (at LSI, the alternative to noise reduction is high-speed, 30 in/sec, elevated levels). Typically-conscious of the monitoring environment, LSI has outfitted their control room with UREI 813 Time Aligned monitors and ADM 4s.

In the forefront of a new generation of Nashville recording, LSI is representative of a growing number of local studios—holding-fast to the "tried-and-true", while experimenting with, and searching for, new techniques and the best application of today's technology to record the best music possible.

Most of the studios in Nashville are single-studio facilities—only a handful have more than one studio. While the market for new recording studios may be approaching the saturation point (currently Nashville supports approximately 120 studios of varying degrees of sophistication), there is still a tremendous amount of upgrading taking place around town. It's clear that the mood in Nashville today is "state-of-the-art" and "how soon can I get it?". ■

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SAM ZAMBUTO

Spotlight on Nashville's Pro Audio Manufacturers

Despite the meager electronics industry, several innovative pro audio equipment manufacturers have firmly planted their roots in Nashville.

FOR AN AREA where the music industry is the third largest business/employer—supporting an incredible array of recording studios, record companies, publishing houses, booking agencies and resident musical artists—Nashville, Tennessee is conspicuously lacking an electronics industry to speak of. Yet despite this lull in electronic activity, a handful of pro' audio recording equipment manufacturers have set up shop in Nashville, in recent years.

One fast-growing and innovative Nashville-based firm is Harrison Systems, Inc., a major designer and manufacturer of audio consoles and related gear for the recording, motion picture, and sound reinforcement industries.

HARRISON HISTORY

Setting up the Studio Supply Company in Nashville, in the early '70s, Dave Harrison became the local distributor of MCI tape machines. While operating Studio Supply Company, Harrison designed and leased to MCI an audio recording console—the 400 Series. In late 1973, along with Tom Piper, Dave Harrison formed Pandora Systems, to manufacture audio equipment—limiters; a digital delay line called the "Time Line;" and the "Speed Freak," a device to manipulate the running time of the MCI tape machine. It was at this time that development started on what was later to become the Harrison 3232 console; although it was originally designed to be licensed to MCI. However, when MCI came out with the 500 Series console, and elected not to license the Harrison design, Pandora built the console itself, in two small rooms in the storage area of the Studio Supply Company. The first 3232 console was shown in December, 1975. In February of the following year, Studio Supply Company was sold and Harrison Systems, Inc. formed. (Headed by Tom Irby, the Studio Supply Company currently represents the Harrison line of audio consoles in Nashville and the Eastern U.S.)

In the four years since its inception, Harrison Systems has developed—under the direction of Dave Harrison, president, and Tom Piper, executive vice president—an impressive line of audio consoles, including: the 24 and 32 Series Master Recording Remix Consoles, the PP-1 Post Production Series Mixing Console, the Alive Console, and the MR-1 Music Recording Console.

THE MR-1

A digital-analog hybrid console, the new MR-1 is the end result of an intense, six-month planning and production effort. The MR-1 represents an interim technology, designed to bridge the time-span between the development of fully-digital consoles that are economically practical and the "level-only automation" analog technologies of the late '70s. The MR-1 achieves sophisticated analog signal processing (automated panning, echo sends, group assignment, echo return and automated insertion of patch points, filter and equalization) via the DCI (Distributed Control Intelligence) concept of placing software-controlled micro-computers into each input module of the console. Harrison Systems first employed the DCI concept in its PP-1 Post Production console—the prototype of which was built for Walt Disney Productions for use on the motion picture, "The Black Hole."

In a 56-input MR-1 console, there are 60 micro-computers; communicating with each other over an asynchronous digital data bus—all group, status, control, and automation data is interchanged digitally.

In addition to the various consoles, Harrison offers the Auto-Set, an automation programmer for digitally-controlled computer mixing. (See **Automation: Its Evolution,** in the August, 1979 issue of **db.**) Slated for its first showing at the AES in May, 1980 will be Auto-Set II, a second-generation automation programmer.

HARRISON LEASING

Responsive not only to the needs of the audio industry in terms of equipment design, Harrison Systems, Inc. has recently formed the Harrison Leasing Corporation—a wholly-owned subsidiary—as a vehicle for leasing high-quality audio equipment. Not limited to Harrison products, the leasing program encourages package leases of studio gear, including high-quality studio equipment manufactured by other companies. Establishment of the Harrison Leasing Corporation became essential in Nashville, since banks and traditional leasing companies—due to their lack of understanding of the music and recording business—have been reluctant to enter into equipment financing for audio products. In fact, a few years ago, two of Nashville's leading banks suspended their leasing operations altogether, and have yet to re-open them—despite the fact that the majority of the leases being written were for the music industry. Early evaluation of the Harrison leasing program has shown rapid acceptance within the industry.

Sam Zambuto is Associate Editor of db Magazine.

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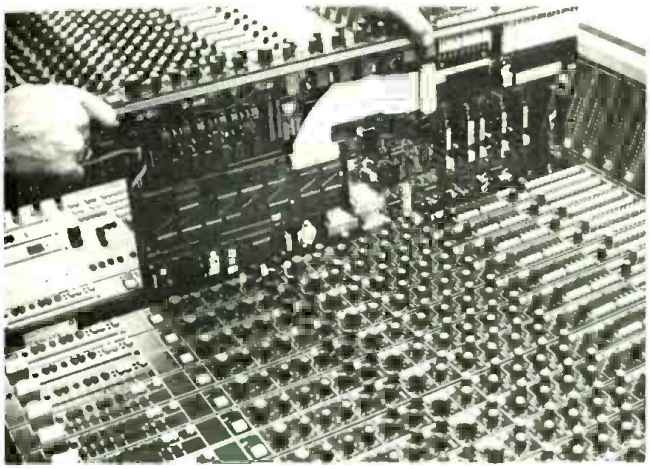


The MR-1, Harrison System's digital-analog hybrid music recording console.

EXTRA, EXTRA—READ ALL ABOUT IT

Soon to be in circulation is a new journal to be published by Harrison Systems, Inc. *Euphony*—Harrison's Journal of Good Sound—will be published quarterly; providing interesting reading about people in the music industry, recording studios, and much more. The premiere issue is slated for Spring, 1980, and will be available, by subscription-only, to qualified people in recording and related professional audio fields. So, if "good sound" is what you're all about, then maybe you should be reading *Euphony*. Contact Millee Satterfield, Editor, at Harrison Systems, Inc., P.O. Box 22964, Nashville, TN 37202. (Tell her db sent you—Ed.)

STUDER REVOX AMERICA

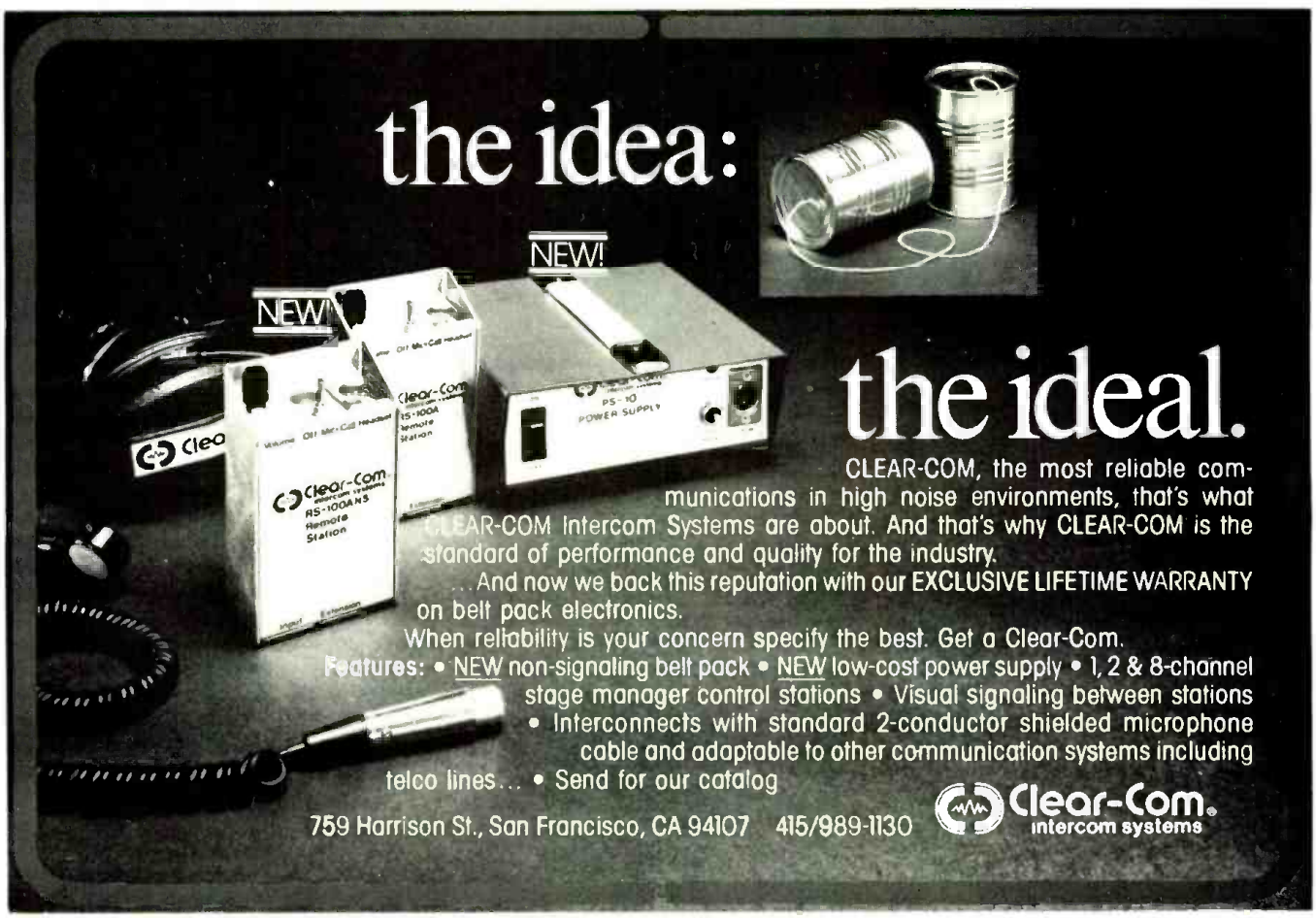
Choosing Nashville as its U.S. base of operation, Studer Revox America, a division of the parent company—Willi Studer International, opened shop in 1975. Originally called Willi Studer America, the name was changed to Studer Revox America to reflect the acquisition of the Revox line from Hammond Industries in New York. While Studer does not maintain a manufacturing plant in the U.S., it does offer complete sales and service centers in Nashville, as well as in New York and Los Angeles. The reasons for choosing Nashville as its U.S. headquarters are varied—but, basically, Nashville provided great appeal as a recording center, in addition to being centrally located from the other major U.S. recording centers.

Accounting for only 15 percent of Studer's U.S. sales, Nashville has been, historically, a rather hard market for Studer to sell—quite frankly, money just doesn't generally seem to be available for a machine in the Studer price range. As of this writing, Studer has yet to sell an A-800 tape machine in the Nashville market; there just isn't the financial impetus. Bruno Hochstrasser, president of Studer Revox America, Inc., characterizes the Nashville pro audio market as being a little more deliberate and careful when considering the purchase of a major piece of recording equipment.

Since coming to Nashville, Studer has enjoyed a very good relationship with Harrison Systems, Inc. Studer has endorsed the Harrison line of consoles, and all Studer's representatives overseas also represent Harrison. Increasing demands for turn-key operations was primarily responsible for bringing Studer and Harrison together, and, as a result, Studer now supplies Harrison consoles in their turn-key packages.

EXPANDED FACILITIES

As a sign of their firm commitment to the U.S. market, and to Nashville in particular, Studer has recently completed a greatly-



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Studer's expanded Nashville facility—housing sales offices, service center and showroom.

expanded facility in Nashville which will house their sales offices, service center, showroom and warehouse.

In addition to the complete line of Studer (A-800, A-80, B-67) and Revox (77A, 77B) tape recorders, Studer is branching out into the small mixing console market with the introduction of the 169, 269, and, most recently, the 369 console which provides up to 32 inputs with four output buses.

ACI DISSOLVED

No stranger to the Nashville recording scene, Claude Hill, of Audio Consultants Inc., represented MCI recording equipment in the Nashville area, following the late-1975 termination of Studio Supply Company as an MCI dealer. When Audio Consultants Inc. was dissolved in February of this year, it represented some 60 lines of equipment. What happened to the Nashville pro' audio market? Nothing, says Claude Hill, that hasn't been happening all across the country. High interest rates, tightened cash flow, and increased transportation costs sliced too heavily into the fixed-margin profits garnered by selling pro' recording gear. All over, the recording industry has been suffering from the economic slump; it's just that the Nashville market seemed to toughen up a little quicker than the rest.

AUDICON—MARKETING, DESIGN & PRODUCTS

Currently operating out of a renovated old church in Nashville, Claude Hill is now the president of Audicon. Established in March 1979, Audicon is composed of three groups: the Marketing Group, the Design Group, and the Products Group. Audicon's church facility includes separate shops for service (electronic, not religious), wiring, drafting, graphics and welding, as well as housing the business offices.

The Audicon Marketing Group functions as a manufacturing and marketing division. Among the products that the Marketing Group manufactures is a plate reverberation system designated, oddly-enough, The Plate. Employing all solid-state circuitry, The Plate utilizes ultra-low-mass piezoelectric contact pickups with high-performance, low-noise amplifiers and FET preamplifiers for the pickup systems; and a voice coil type plate driver, low-noise power amplifier for the drive system. Reverberation time of one-to-four seconds is adjustable at the unit itself, or via a remote control. The reverb plates are manufactured in the chapel area.

Also manufactured by the Audicon Marketing Group is the Audicon Alpha I monitor—a 16 cu. ft. enclosure with double 15-inch woofers and a horn (all JBL components). A control room monitor, the Alpha I was designed, in collaboration with John Storyk of Sugarloaf View, to play loud and accurately—offering a flat tuned frequency response, 25 Hz to 20 kHz, at all levels from 70 dB SPL to 118 dB SPL. A smaller monitor, the Alpha II (in prototype) is designed for smaller studio applications, and utilizes a Gauss low-end in combination with a JBL horn.

Other items handled by the Marketing Group include: a headphone box, a direct box, and a specially-designed cable for use in multi-track audio studio installations—individually-jacketed and shielded, the cable is available in 4, 8, 10, 24, and 32-pair configurations. In addition, the Audicon Marketing Group will be handling the exclusive import and North American marketing of Roger Barth products.

The second division of Audicon is the Design Group, staffed by Claude Hill and Robert Austin Belmear. The Design Group offers complete studio design services—architectural, acoustical, lighting, audio and electrical plans from the ground up. Some of the studios which have employed the services of the Audicon Design Group are: Ardent Recording, Memphis, TN; Soundshop, Nashville, TN; and Muscle Shoals Sound, Muscle Shoals, AL. **(See Muscle Shoals Sound Studios, in the January, 1980 issue of db.)**

Representing the third facet of Audicon is the Products Group; where, as Claude Hill put it, "radical" products are currently under design. Such as....? Does Macy's tell Gimbels?

ALLISON RESEARCH

Allison Research Inc., now dealing primarily in automation systems, moved to Nashville from the West coast in 1972. While Nashville represents only 5 to 10 percent of Allison's overall business, Paul Buff, founder and president of the company, made the switch because the attitude, the way of life, and the productivity was better in Nashville. More than half of Allison's engineering staff is "imported" from other areas, since there is still a scarcity of local electronic engineers and technicians due to Nashville's meager electronic industry.

Basically, the Allison product line consists of two signal processing devices—the Kepex and Gain Brain—a wide

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automation line, and the VCAs (Voltage-Controlled Amplifiers) to support their automation line.

The Allison 65K Programmer line consists of the 65K-A1-XX series with the capacity of 64 analog functions in increments of 16 functions; and the 65K-A2-XX expander package which allows an additional 192 analog functions in increments of 16 functions. In all, the 65K Programmer may be expanded to a maximum capacity of 4096 analog functions.

The Allison Fadex Automation System is a programmable fader system—using a conventional Penny & Giles fader with the "read," "write" and "update" modes of operation—designed to interface to the 65K automation programmer. The Allison Fadex system automates the audio levels via d.c. control voltages from the faders, and allows the all-important VCA grouping essential to automation.

The next logical step in the automation process, according to Paul Buff, is that the VCA could be used to do any limiting or expanding necessary, without subjecting the signal to outboard equipment. The Allison Kepex II, a second-generation successor to the original Kepex 500, is designed with that type of capability. In essence, the Kepex II is a voltage-controlled device—all parameters are controlled by linear taper front-panel controls, which are all fed from a reference voltage of +5 V d.c. What this means, in practical terms, is that the Kepex II could easily be hooked up to an automation or memory system. At this time, it would require some interfacing, but the design elements of the Kepex II provide that capability.

Paul Buff doesn't see full, wide-spread automation of the whole console until some work is done in getting the console more compact and a little less expensive. Systems, in the future, are going to have to come down in both size and cost—a system, perhaps, of central access; a direction Allison began work on a number of years ago, but which was rejected by many, at the time, as being too "radical."

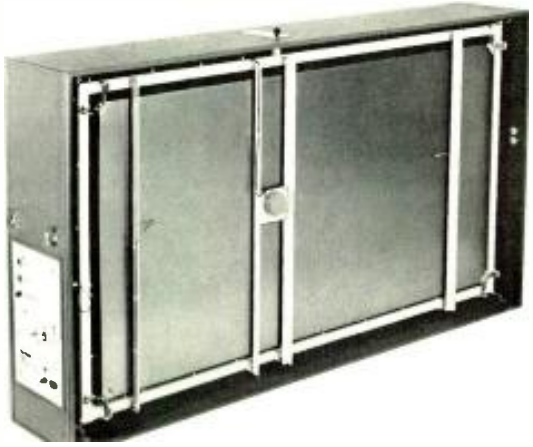
Active in the design of VCA devices for over ten years, Allison achieved, in 1979, the realization of a simple, cost-effective VCA device—the EGC-101—which revolutionized the VCA art. OEM sales for Allison's VCA's have been very strong. Allison supplies VCAs to many of the console manufacturers—after all, a console is only as good as the VCAs in it.

Within their facility, Allison maintains a design and graphics department, a service and testing lab, production facilities, a large inventory of parts, a plastics department (where various molded-plastic parts, such as VCA shells, are produced from silicon molds), and a woodworking shop (where the wood forms for the silicon molds are produced).

MCI NASHVILLE

MCI, Inc., the Florida-based console and tape machine manufacturer, has recently opened a sales and service center in Nashville. The MCI Nashville office will be under the supervision of Graeme Goodall, who previously worked for Audio Consultants, Inc.

The Plate, Audicon's plate reverberation system provides one-to-four seconds of adjustable reverberation time.



Allison Research's Kepex II, a ten-year rethinking of the original Kepex 500.

In the early '70s, MCI was represented in Nashville by Dave Harrison's Studio Supply Company. With the formation of Harrison Systems, Inc., and their directly competitive line of audio consoles in late '75-early '76, MCI terminated its relationship with the Studio Supply Company and awarded Audio Consultants, Inc. the Nashville MCI dealership. When Audio Consultants, Inc. was dissolved earlier this year, MCI decided to go the route of operating its own sales and service center in Nashville.

Housed in a 2,770 sq. ft. facility, the MCI Nashville Sales and Service center maintains 500 sq. ft. of office space, and 2,200 sq. ft. of warehouse area—1000 sq. ft. of which is dedicated to the service shop. In addition to Graeme Goodall, there are two MCI-trained technicians providing 24-hour service, seven days a week.

The MCI Nashville office will be supplying MCI gear to Nashville and the surrounding areas—working along with studio designers and studio supply houses. In this new mode of operation, MCI customers will receive factory-direct warranty service, since the MCI Nashville office is wholly-owned by the parent company.

In so far as trends in the studio market are concerned, Goodall sees a large amount of trading taking place in Nashville—large corporations are buying existing studios. Many freelance producer/engineers, who really don't care to be involved in the business aspects of recording, are selling their large studios and building small overdubbing/remix rooms at home. Relatively few new studios are under construction in Nashville—although many existing studios are upgrading. Graeme sees a great deal of used equipment trading in the months ahead—he calls it "the year of the good used equipment."

NASHVILLE NEVE

Rupert Neve, Inc., a well-known manufacturer of audio mixing consoles, has also just-recently opened a sales office in Nashville, in an effort to solidify the company's local business position, and to actively pursue broadcast sales in the Midwest and Southeast.

Over the years, Neve has made small inroads into the Nashville recording studio market—only a handful of Nashville studios sport Neve consoles. Opryland Productions utilizes a large custom Neve console for its radio production and live broadcast of WSM's Grand Ole Opry radio program.

Neve's Nashville regional sales office is headed by Glen McCandless, who comes to the position with four years of sales and management experience in the high-end of consumer audio from Anderson Audio in Nashville. ■

A Directory of Nashville manufacturers appears on page 55.

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LEONARD FELDMAN

Changes Loom For Both AM and FM Broadcasters

Looming in the future we find AM stereo and stereo TV sound. But, when and how will the FCC react?

IF YOU have been laboring under the delusion that broadcasting standards and procedures are pretty-well fixed and stable in this country and elsewhere, you may be surprised to learn that there are, behind the scenes, several domestic as well as international bodies out there seeking to upset the status quo. That's not to imply that all changes are necessarily bad, or, that we ought to leave things as they are. In general, broadcasting in this country grew like the proverbial Topsy and, in certain respects, current practices are somewhat chaotic, to say the least.

In this country, too, the processes whereby changes in broadcasting standards and procedures can be effected are extremely laborious and lengthy, often involving more than just the Federal Communications Commission which, in and of itself, is not an agency that acts in haste very often. In the following paragraphs, I will attempt to discuss just a few of the issues and pending decisions that might well affect broadcasters and broadcasting in the months and years ahead. Needless to say, the repercussions could have a profound effect on the recording industry as well.

CHANGES IN AM

As I write this, the nations of the Western Hemisphere are meeting at the Region 2 Administrative Radio Conference in Buenos Aires, Argentina to consider among other matters, a change in channel spacing on the AM band from its present 10 kHz, down to 9 kHz. Our own FCC voted to recommend that the United States propose such a reduction in channel bandwidth. As of this writing, FCC rules specify that AM broadcast stations operate on 107 channels, spaced at 10 kHz intervals, from 540 kHz to 1600 kHz. Approximately 2,250 full-time stations have been assigned to these channels. According to the FCC (and simple math), a reduction of channel spacing to 9 kHz would increase the total number of channels from 107 to 119 and would permit the authorization of an additional 200 to 1400 full-time stations, depending upon the action of the conference and subsequent frequency assignments by the FCC.

SOME OPINIONS VARY

While all of the FCC commissioners ultimately concurred in the decision to recommend the narrower channel spacing, at least two...(Quello and Washburn) had doubts about the wisdom of the decision. According to Commissioner James H. Quello, "...the tests and measurements conducted by NTIA (National Telecommunications Information Administration) and three of our licensees demonstrate that theoretical projections and practical results quite often differ. The fact is that none of the three stations was able to operate within required parameters after shifting frequency." Commissioner Quello goes on to point out that he feels that the potential impact upon stereo AM has not been fully assessed. We will have more to say about stereo AM in a moment. Commissioner Quello points out that the task force assigned to study this matter recognized that it might be necessary to restrict the bandwidth of emissions to 5 kHz to avoid unacceptable adjacent-channel interference. He further notes that, while it is still possible to have stereo under restricted-bandwidth conditions, the appeal of this new service without adequate audio fidelity, may be limited.

As for reduced channel spacing providing a boon to minority groups who want to "get on the air" (the ostensible major reason for the change in the first place), the Commissioner points out that the lack of comments from minority individuals and organizations would seem to indicate that they don't particularly welcome this proposal to reduce channel bandwidth for their benefit.

TECHNICAL DEVELOPMENTS SLIGHTED

On a technical level, the decision by the FCC to support this narrow bandwidth cause completely ignores the growing trend on the part of radio makers to use frequency-synthesized tuning schemes in their products. In a frequency-synthesized tuner, incremental difference between channels is pre-determined. For example, AM radios now employing this technique can tune to 550, 560, 570 kHz, etc. but *cannot* tune to 559, 568, 577 kHz, etc. as would be required if the 9 kHz spacing rule goes through. No one can say just how many frequency-synthesized tuners are out there at the moment, but their numbers are growing (particularly in the car stereo market), and will be much greater

Leonard Feldman is the technical director of the Institute of High Fidelity. Mr. Feldman was chief engineer of Crosby Electronics, and worked with the late Murray Crosby on early stereo FM systems.

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than they are now by the time the 9 kHz change is implemented. Possibly, millions of AM radios and/or tuners may then be obsoleted with one fell swoop!

AM STEREO

Most proponents of AM stereo, when asked about the possible implications of 9 kHz spacing, maintain that the change should have no great effect upon their proposed systems. In that connection, although the FCC's AM Stereo Docket (Number 21313) was given almost no priority at the end of 1979, pressure brought about by broadcasters and other interested parties seems to have altered the FCC's position in this regard and, as of early 1980, a decision before mid-year seemed to be in the offing. There is absolutely no way of predicting, at this time, which of the systems the FCC seems to be favoring but I am prepared, at complete risk to my reputation as a prophet, to name the system that I believe will prevail. I do so on one condition: that you *not* write me letters if I am proven wrong even before these words appear in print. I therefore, predict victory for the Kahn-Hazeltine system, the first of the five stereo AM systems to be developed and the one which has probably been more-thoroughly tested than any of the others.

FM MAY BE IN FOR CHANGES, TOO!

In a Petition for Rulemaking dated April 17, 1979, the NTIA offered for consideration a long list of suggested revisions to FM broadcasting rules. Here too, the avowed purpose was to permit the FCC to assign new commercial FM station licenses to minority owners who, the NTIA feels, have been denied access to public airwaves because of a lack of spectrum space under present rules.

Part of the NTIA Petition deals with the use of directional antennas, terrain shielding and the creation of more classes of stations. These changes require some study before implementation can take place, but none seem to pose a threat to quality stereo FM broadcasting or even to proposed systems of four-channel FM broadcasting, about which more in a moment. However, the final section of the NTIA proposal presents a clear danger to quality FM as we know it today.

ABOUT FACE

In the Petition, the NTIA first tells us how much FM receiver performance has improved over the last several years, and then goes on to suggest that these painstakingly-achieved improvements make it possible, and even worthwhile, to consider *narrowing* the FM channel bandwidth from its present 200 kHz to 150 kHz or, even worse, to 100 kHz! To justify this return to low-fidelity FM, the NTIA notes that there have been improvements in capture ratio and alternate-channel selectivity, primarily in high fidelity-grade tuners and receivers. What they are saying, in so very many words, is; now that the high fidelity industry has managed to improve the performance of its products so that interference from adjacent or alternately-spaced channels is no longer much of a problem, it is time to retrogress to the type of FM performance available in the 1950's and 1960's!

After suggesting that the FCC initiate a substantial study and undertake an inquiry into the feasibility of reducing adjacent channel frequency offset, the NTIA goes on to admit that they recognize that reductions in bandwidth have real or potential disadvantages, among them (a) incurring the costs of changing transmitter frequencies, (b) producing some increased interference on existing receivers, (c) reducing, or even eliminating entirely, certain applications of Subsidiary Communications, or SCAs (SCA is the multiplex sub-carrier service used by certain background music operators such as Muzak, and more recently by Talking Books For The Blind services in the Mid-West and elsewhere and is based upon the use of a 67 kHz sub-carrier riding piggy-back on the main FM carrier. This is now possible even when an FM station broadcasts in stereo), (d) increasing the cost of future receivers and, finally, (e) restricting or precluding the adoption of some systems of quadraphonic broadcasting. In addition to these disadvantages, pointed out by the very agency that is proposing the new bandwidth restrictions, I can think of a few more.

SELECTABLE I-F BANDWIDTH RECEIVERS

One of the most-useful circuit refinements that has recently appeared on higher-quality FM tuners and receivers is selectable bandwidth. Products equipped with this feature have a front panel switch which is usually marked "narrow" and "wide." This switch permits the user to select either of two distinctly different degrees of selectivity. If the user chooses the "narrow" position of the switch, the product is better-able to reject signals that are only one or two channel-widths apart. But there is a trade-off involved. With narrower bandwidth (or higher selectivity) comes higher distortion. This is particularly true in the case of stereo FM or, possibly in the future, in the case of multi-channel or four-channel FM, where sidebands of sub-carriers extend all the way out to the edges of the *present* channel bandwidth and beyond.

Manufacturers, fully aware of this tradeoff, therefore offer an alternative switch setting; the "wide" switch position. If you are fortunate enough to live in an area where stations are widely separated on the FM dial, you flip the switch to the "wide" setting and enjoy ultra-low distortion and, often, much-greater stereo separation than you would get in the "narrow," or high-selectivity, mode. If the FCC were ultimately to reduce the channel bandwidth of FM broadcasting to 100 kHz, the owners of these fine sets might just as well resign themselves to using only the narrow setting. In the wide setting, adjacent-channel selectivity is usually no more than a few dB at best—and that's based upon a present-day adjacent-channel spacing of 200 kHz.

FREQUENCY SYNTHESIZED FM TUNERS

Another recent innovation in FM technology—which the NTIA proposal completely ignores in trying to make its case—is the crystal-controlled, frequency-synthesized FM tuner or

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receiver. As most readers probably know, a slightly-detuned tuner delivers increased distortion, which rises almost exponentially as detuning increases. Frequency synthesis, in which tuning is precisely referenced to a quartz crystal oscillator, insures against incorrect tuning and therefore guarantees the low-distortion performance of which modern FM sets are capable. But frequency-synthesized tuners work in 200 kHz increments in this country. You tune in precise steps, from 88.1 MHz, to 88.3 MHz to 88.5 MHz and so forth, all across the FM dial. You cannot tune to 88.25 or 88.4 or 88.55, as you might have to do if channel spacing were at 150 kHz intervals. And, as you might have guessed, the frequency-synthesized tuners are usually more expensive than conventional sets, so that those dedicated FM listeners who have invested, or will invest, in these more sophisticated products have the most to lose monetarily if the FCC were to deal seriously with this aspect of the NTIA proposal.

It is interesting to note that, upon digesting the NTIA proposal, the FCC sent out a request to many organizations (even I got one, believe it or not) in which they asked for bids for a nine-month study of the possible effects of reduced FM channel bandwidth. The study involved such formidable tasks and such complex ones that, according to the latest word I have, there were no bids submitted by private industry. The fact that this study has not been initiated, however, is no guarantee that the matter will be dropped. On the contrary, the question of narrower FM bandwidth has been rearing its head for many years and is not about to go away. Broadcasters, as well as interested FM listeners, are urged to be vigilant, lest we be treated to a *fait accompli* before we have a chance to object.

QUADRAPHONIC BROADCASTING STILL POSSIBLE

Remember four-channel sound? Back in the early seventies, when many of us thought that quad was to be the sound of the future, the industry, with the tacit encouragement of the FCC, went through all sorts of gyrations to come up with a system whereby discrete four-channel FM transmission might be successfully accomplished. As is so often the case, the industry outdid itself, coming up, instead, with at least six systems (more, if you include so-called 4-2-4 matrix four-channel systems). That called for an FCC Docket for rule-making, which was issued way back in 1972 or 1973.

Well, believe it or not, the Docket has never been closed, and neither has it been acted upon. Most broadcasters would be quick to point out that there is, at the present time, no great urgency about this matter. But some maintain that with the certain coming of AM stereo, suddenly the marketability of AM radio will once more be on a par with FM. The clear advantage enjoyed by FM broadcasters in being able to transmit programs stereophonically for the past two decades has been deemed an important contributing factor in the recent economic success of FM. With that advantage gone once AM stereo arrives, FM broadcasters may once more have to look for a technical advantage, especially since AM stereo is very likely to be more successful in car stereo systems than is FM stereo, which tends to suffer from multipath noise and distortion in a moving vehicle.

So, from the FM broadcaster's point of view, four-channel capability may yet become desireable, if not essential. No wonder, then, that there are once again rumblings from Washington that perhaps, at long last, the FCC will act in the matter of Docket 21310 (the Quad Docket) and permit broadcasters to standardize on one type of discrete four channel FM broadcast system. There are those in the industry who think that such action by the FCC might in itself prompt a resurgence of interest in quadraphonic sound.

FURTHER INTO THE FUTURE

It's been over a year-and-a-half since TV broadcasters in Japan began broadcasting the sound portion of their programming in two-channel form. Note that I did not refer to this new audio transmission as stereophonic because, in fact, some of the time it is bi-lingual rather than stereophonic. Motion pictures, for example, may be shown with an original sound track (if they are not of Japanese domestic origin) on one audio channel and in a dubbed Japanese-language version on the other channel. Of course, the most effective use of stereo TV occurs when live or taped concerts are shown.

When you consider the fact that the system used for two-channel TV audio broadcasting is very much like the system used for FM stereo broadcasting in this country and in Japan, you must wonder what is taking this country so long to follow suit. Clearly, the needed technology exists and the transition would not be difficult, particularly now that audio diplexing on coaxial cable is possible, as is satellite transmission of audio for TV broadcasters. Fortunately or unfortunately, depending upon your point of view, in this country it is necessary to petition the FCC for rule making, and that in turn leads to yet another notice of inquiry, followed in due course by the issuance of a docket for possible rule-making. In Japan, of course, if the state-run NHK TV network, in collaboration with major industry and government decides that a given system is right for TV stereo audio, they simply approve that system and authorize its use. Here, things are likely to take *quite* a bit longer. Still, it is encouraging to note that the Electronics Industries Association has already begun committee deliberations regarding multi-channel TV. This should eventually lead to field-testing of some three-or-more proposed systems (including the one used in Japan) and the preparation of a technical report to be submitted to the FCC. That, after all, was the course followed in the development of FM stereo twenty years ago, as well as the course followed in evaluating many of the systems in connection with the soon-to-be-promulgated AM stereo rules. On the other hand, don't hold your breath in anticipation of an early decision for multi-channel TV. Remember, this was the same course of action followed in connection with attempts to arrive at a system for quadraphonic broadcasting! ■

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ALMON H. CLEGG

Using Thevenin's Theorem in Audio

Using the theorem in audio circuit applications, quick and precise measurements are readily available.

SOME HAVE FORGOTTEN, and others perhaps never knew, what Thevenin's Theorem is, and how to use it. Offered here is a brief review of this principle, and an example or two of how it can be used in audio.

Mr. Thevenin said that any complicated circuit with an output to which a load will be connected, can be represented by a simple "equivalent circuit." This will consist of a constant voltage source in series with a single impedance.

Often, such an equivalent circuit will help simplify calculations in circuit design and interfacing. For example, it is far easier to determine the effect of a load resistance when the circuit to which it is to be connected consists of a single impedance/voltage combination, rather than a complex collection of active and passive components.

EQUIVALENT VOLTAGE AND RESISTANCE

When the actual circuit is not overly complex, a three-step process gives us E_{TH} and R_{TH} —the Thevenin's equivalent voltage and resistance of the circuit.

1. Remove the load.
2. Calculate the voltage that now appears across the output terminals.
3. Replace the voltage source by a short-circuit, and calculate the total circuit impedance, as measured at the output terminals.

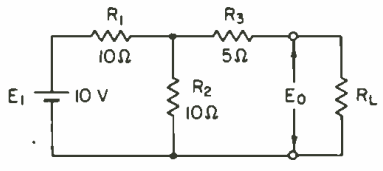

Figure 1

The circuit shown in FIGURE 1 may be used as our first example.

Step 1. Disconnect the load, R_L.

Step 2. Compute the voltage appearing at the output. Since the load is now open-circuited, there is no current flow through R_3 and hence, no voltage drop across it. Thus, the output voltage is merely the voltage across R_2, since R_1 and R_2 form a simple series divider.

$$E_O = \left(\frac{R_2}{R_1+R_2}\right) E_I = \frac{10}{20}(10) = 5v = E_{TH}$$

Step 3. Find the resistance looking back in with the voltage source $E_I = 0$. (remember, a voltage source is defined as a constant voltage with an internal resistance of zero ohms.) The circuit becomes as shown in FIGURE 2.

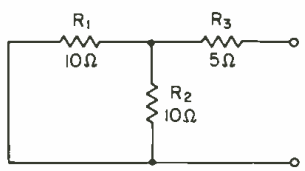

Figure 2

R_{TH} —the equivalent resistance—is, clearly R_3 in series with the parallel equivalent of R_1 and R_2 or 5 ohms and 5 ohms for a total of 10 ohms. The final equivalent circuit, therefore, is shown in FIGURE 3.

Now, the voltage across, and the current through, any load resistance, R_L, is the same in both circuits. The load resistor cannot determine, and doesn't really care, which circuit it is connected to. And certainly the circuit seen in FIGURE 3 is much simpler than the one in FIGURE 1.

A second example is shown in FIGURE 4, with the solution left as an exercise for the reader. Again, the Thevenin's equivalent circuit makes further computations a lot easier.

Almon H. Clegg is the manager of the Audio Engineering Department Product-Engineering Division at Technics.

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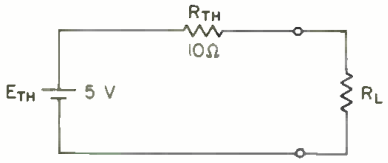


Figure 3

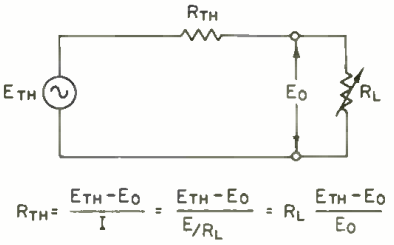


Figure 5

LABORATORY TESTING

Now let's consider how we would measure the circuit in a laboratory situation. First, remove the load, and measure the output voltage with a voltmeter. Next, remove the batteries and replace them with a short (if there were current sources, they would be replaced with an open circuit). Measure the resistance across the output terminals with an ohmmeter.

In practical circuits, containing transistors, capacitors, etc., it is difficult, if not impossible to do this and an alternate method must be used to determine the R_{TH}. Remember from our knowledge of a series divider, when two resistors are of equal value, the output voltage across either resistor will be half of the applied voltage. Therefore, we may place a resistor substitution box across the output (which is now in series with R_{TH}) and slowly reduce R_L from a high value until the voltage drops to half of the open-circuit voltage. Now, the R_{TH} is equal to R_L.

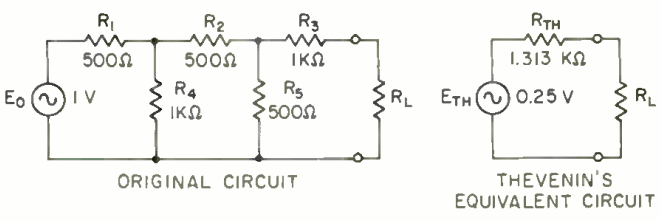
Now we are ready to take a look at a real live amplifier and find its equivalent circuit. Let's put it on the bench and feed a signal into it to produce some nominal output voltage at 1kHz. An output of 1V may be sufficient. With no load connected, the output being set for 1V provides E_{TH}. Putting on the sub box and thumbing down from 100k to 10k to 1k to 100 and finally to 10 ohms shows no sign whatsoever of the output voltage dropping, let alone to the half-way point. At this moment, one is wise to remember that the damping factor of an amplifier is very high. Since damping factor is the ratio of the rated load to the internal, or Thevenin's resistance, this internal resistance must be very low. In an amplifier rated for an 8 ohm load and a D.F. of 100, R_{TH} = 0.08 ohms, which is far below the rated load. (For more on damping factors, see The Sync Track column in the July, 1978 **db**—Ed.)

NEGATIVE FEEDBACK

The condition described above is the product of negative feedback. Negative feedback, in addition to the many other virtues it provides, has the effect in amplifiers of lowering the value of Thevenin's equivalent resistance. Properly applied, it can reduce it to values of less than 0.01 ohm. This makes the amplifier, in essence, a constant voltage source, which is highly desirable, since we usually want the voltage across the loudspeaker to remain constant, even though its impedance may vary from 6 or 7 ohms to 60 or 70 ohms at various frequency points. (This also invalidates the use of the maximum power transfer theorem!)

How, then, do we determine R_{TH} for an amplifier with lots of feedback? It can be done by using simple circuit analysis. Using FIGURE 5 for a model, we can compute R_{TH} by loading the amplifier down until a perceptible drop in voltage can be seen (but not so much as to cause the amplifier damage!)

Figure 4



For a recent amplifier, a 4 ohm load caused the output voltage to drop from 1V to 0.9V. Thus

$$R_{TH} = 4\left(\frac{0.1}{0.9}\right) = 0.44\Omega$$

As illustrated in the example above, most modern amplifiers, preamps, mixers, etc. employ negative feedback sufficient to make the output resistance much lower than the rated load. It is therefore prudent for the system designer to visualize the Thevenin's equivalent as the interface connections are specified. Often times, levels and impedances must be taken into consideration to provide optimum system performance.

PUBLIC ADDRESS APPLICATIONS

The concluding example will show how Thevenin's Theorem was used to solve a public address system problem. A microphone mixer with a balanced-line, 600 ohm output at +4dbm, is used with a high quality, high fidelity power amplifier. The system works okay but two operating problems exist: The system gain is much too high, because the power amplifier has a sensitivity of less than 1V for full power output, and the output of the mixer is capable of several volts. Additionally, the input resistance of the power amp is in excess of 50 k ohms, which is essentially an open circuit to the output of the mixer. The noise level is also high, because of the excessive gain. The solution is to reduce the power amplifier input to a level which will allow us to raise the operating voltage in the mixer closer to clipping, so as to force the signal-to-noise ratio as far down as possible.

Loading the output of the mixer excessively will cause distortion and potential damage to the circuit elements. A simple solution is to divide the output of the mixer to the level required by the amplifier as shown in FIGURE 6.

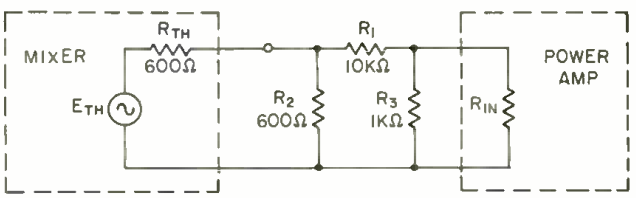


Figure 6

Since the divider, R_1 and R_3 are a 10-to-1 ratio, it provides 20dB of attenuation between mixer and amplifier. In this actual example, the attenuation was still insufficient to give of full scale Vu deflection during peak levels for the auditorium. By observation, it was evident that another 6 dB attenuation was necessary. A final step was to place an additional 1k ohm resistor across R_3, which gave the desired result.

In summary, the equivalent circuit concept which was given to us by Mr. Thevenin is a valuable tool in helping us to understand and solve interface problems in audio and related equipment. ■

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16 MELCOR GME 20 EQ's as lot, $1,700.00; 4 Altec 771 B bi-amps, $400.00; 350 playback electronics, 3 channel (stereo + mono), $250.00; and A7 16 ohm woofer, $50.00. **(212) 753-6446.**

FOR SALE: INTERFACE 16 x 4 recording/mixing console, excellent condition. For details, call **Bill Castner, We Three Productions, (313) 767-7426.**

AMPEX, OTARI, SCULLY—In stock, all major professional lines, top dollar trade-ins; 15 minutes George Washington Bridge. **Professional Audio Video Corporation, 384 Grand Street, Paterson, New Jersey 07505. (201) 523-3333.**

SCULLY 280—1"-8 CHANNEL with Motion Sencing, factory console, $6500. 2 Ampex 351-2 $1500 ea. 2 Ampex 351-1 factory console $1200 ea. 1 Ampex AG-350-2 factory console with ¼" P/B head $1700. 5 AM-10 Ampex stereo mixers $250 ea. Ampex FR-1100 decks, 300 decks $250 ea. Ampex PR-10-1 $150. Call **David Lundy (606) 546-6650, P.O. Box 485, Barbourville, KY. 40906.**

WANTED

WANTED: RECORDING EQUIPMENT—mikes, recorders, consoles, outboard gear. **Greg Field, Box 243, San Mateo, CA 94401. (415) 343-1353.**

EMPLOYMENT

WANTED: POSITION as a 1st or 2nd recording engineer, or position with a good professional sound company or professional audio equipment company—sales. Experience in studio recording, live sound reinforcement, video work and audio installations. Good, hard, efficient worker. **Eddie—(205) 263-6353.**

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BUSINESS OPPORTUNITIES

COMPLETE AUDIO STUDIO package available in Tulsa, including MOOG 55 and 3 module Arp synthesizers, 8-track and 2-track Ampex recorders with dbx units, mixing board and much more. Call **(602) 488-3454, or P.O. Box 1316, Carefree, Arizona 85377.**

SERVICES

CUTTERHEAD REPAIR SERVICE for all models Westrex, HAECO, Grampian. Modifications done on Westrex. Quick turnaround. New and used cutterheads for sale. Send for free brochure: **International Cutterhead Repair, 194 Kings Ct., Teaneck, N.J. 07666. (201) 837-1289.**

MAGNETIC HEAD relapping—24 hour service. Replacement heads for professional recorders. **IEM, 350 N. Eric Drive, Palatine, IL 60067. (312) 358-4622.**

JBL AND GAUSS SPEAKER WARRANTY CENTER. Full lines stocked. Instant recone service, compression driver diaphrams for immediate shipment. **Newcome Sound, 4684 Indianola Ave., Columbus, Ohio 43214 (614) 268-5605.**

ACOUSTIC CONSULTATION—Specalizing in studios, control rooms, discos. Qualified personnel, reasonable rates. Acoustilog, Bruel & Kjaer, HP, Tektronix, Ivie; equipment calibrated on premises. Reverberation timer and RTA rentals. **Acoustilog, 19 Mercer Street, New York, NY 10013 (212) 925-1365.**

AMPEX SERVICE COMPANY: Complete factory service and parts for Ampex equipment; professional audio; one-inch helical scan video systems; video closed circuit cameras; instrumentation consumer audio; professional audio motor and head assembly rebuilding. **2201 Lunt Ave., Elk Grove Village, IL 60007; 500 Rodier Dr., Glendale, CA 91201; 75 Commerce Way, Hackensack, NJ 07601.**

MULTI-TRACK RECORDING specialists —1-2-4-8-16-24 tracks, authorized dealer for Tascam, Otari, Ampex, Teac, Technics, AKG, AB Systems, Crest, SAE Pro, dbx, Orban, Tapco C12, Audioarts, Loft, Lexicon, Ashly Audio, Altec, PAS, PSL, Shure, and many more. Single items or complete studio packages. Studio design and construction. Phone or write for a prompt written quotation. **Professional Sound Labs, Inc., 42 North Franklin St., Hempstead, NY 11550. (516) 486-5813.**

INDEPENDENT LABORATORY—Test and evaluation of audio and RF equipment and systems. FCC type acceptance/certification. DOC (Canada) type approval. **Hyak Associates, 7011 Calamo Street, Suite 107, Springfield, VA 22150 (703) 451-1188.**

(Continued from page 47)

NASHVILLE DIRECTORY

Allison Research, Inc.
2817 Erica Place
Nashville, Tennessee 37204
(615) 385-1760
Contact: Paul Buff, Norman Baker

Audicon
Marketing, Design & Products Groups
1200 Beechwood Avenue
Nashville, Tennessee 37212
(615) 256-6900
Contact: Claude Hill

Harrison Systems, Inc.
P.O. Box 22964
Nashville, Tennessee 37202
(615) 834-1184
Contact: Dave Purple

MCI, Inc.—Nashville, Office
Sales and Service Center
Suite 105
176 Thompson Lane
Nashville, Tennessee 37211
(615) 832-8914
Contact: Graeme Goodall

Rupert Neve, Inc.
Nashville Regional Sales Office
P.O. Box 120907
Nashville, Tennessee 37212
(615) 385-2090
Contact: Glen McCandless

Studer Revox America, Inc.
1425 Elm Hill Pike
Nashville, Tennessee 37210
(615) 254-5651
Contact: Bruno Hochstrasser, Douglas Beard

Studio Supply Company
P.O. Box 280
Nashville, Tennessee 37202
(615) 327-3075
Contact: Tom Irby

Valley Audio
2821 Erica Place
Nashville, Tennessee 37204
(615) 383-4732
Contact: Robert Todrank

Valley People, Inc.
2821 Erica Place
Nashville, Tennessee 37204
(615) 383-4737
Contact: Gary Carelli

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db People/Places/Happenings

• **Panasonic Co.**, Secaucus, NJ, has announced the formation of the new **Recording and Broadcast Division** to serve the needs of the professional sound markets, and, more specifically, the needs of the recording and broadcasting industries. The new Recording and Broadcast Division will be headed by **Jim Parks**, formerly assistant general manager in charge of the Technics department.

• The addition of **M. Travis Ludwig** to **Electro-Voices** marketing staff was announced by company spokesman. Ludwig will be responsible for new product development and the development of marketing strategies for Electro-Voice professional microphones and **Sentry** studio monitors. The new director comes to Electro-Voice from the **University of Illinois** where he recently completed studies in Audio Acoustics and Sound Engineering. He has also been involved in sound reinforcement systems design, recording and construction, and operation of recording studios.

• **Soundcraft Electronics Ltd.**, of London, announces the appointment of **M. Thomas Taylor** as president of **Soundcraft, Inc.** Taylor brings to Soundcraft six years of organizational and sales experience as president of **Pro-Co Sound, Inc.**, a manufacturing firm and retail outlet of professional quality sound systems.

CLARK DUFFEY

• **Clark Duffey** has been named market development manager for professional audio products, by **3M's Mincom Division.** In his newly created position, Duffy will endeavor to develop and expand the market for 3M's entire professional audio line, with emphasis upon the digital mastering systems. Mincom introduced multi-track analog equipment in the early 1960's and later, in 1972, its notable 24-track M79 recorders. Last year the division delivered the first commercially produced multi-track digital mastering systems for audio use. Duffey was most recently in 3M's Public Relations Department, which he joined in 1969. He is a 1962 graduate of the University of Missouri.

• **David Hadler**, of **Quad-Eight**, was recently appointed National Sales Manager. Hadler spent ten years in the professional market as an audio designer and consultant for custom public address applications and tour engineer. He also served as producer for the Philadelphia Music Festival back in April 1967.

• **Ampex Corporation** recently agreed to be acquired by **Signal Companies, Inc.**, a diversified holding company, in a stock deal worth approximately $415 million. The proposed transaction calls for an exchange of .79 of a Signal share for each Ampex share. Ampex has an estimated 11 million outstanding shares of common stock as well as 1.7 million shares reserved for employee stock options and convertible debentures. The company is one of the nations major suppliers of professional audio and video equipment. In addition, Ampex is a supplier of semiconductor components, such computer peripherals as disk and tape storage drive devices and memory cores, and recording tape. The merger should close by **mid-1980.**

• **CBS Video Enterprises Division** has announced the appointment of **Theodore R. Sullivan** as vice president of finance for the division. In this position, Mr. Sullivan will be responsible for the financial, planning and administrative functions of the newly-formed video division. He has served in many different positions, since coming to CBS in 1960. A graduate of LeMoyne College and Columbia University, Sullivan holds a Masters Degree in Business Administration.

• **Technical Audio Products Corporation (TAPCO)** recently announced the appointment of **Jim Loppnow** to the position of sales manager. Loppnow joins TAPCO bringing with him a background in the pro audio industry. He had been most recently employed as marketing manager of **Biamp Systems** of Portland, Oregon. Loppnow will be assigned the responsibility of administering the new TAPCO "TLC" Dealer Program and in continuing the development of a network of US and overseas markets.

• **Robert M. Schmetterer**, a pioneer in the high fidelity industry, died this past January, at the age of seventy-one, following a brief illness. Mr. Schmetterer was founder and President of **Hartley Products Corporation** (1953), the American counterpart to the **Hartley Company, Ltd.** of England, and had held the position of Chairman of the Board of Hartley since 1976. In his early years Mr. Schmetterer worked for Paramount Studios in New York and went on to open retail electronics stores in New York City that specialized in radio, television, and hi-fi sales and service. He began in 1949 to import Hartley hi-fi products and this led to his founding Hartley Products Corporation (USA). Mr. Schmetterer was responsible for many new and innovative products. He was the first importer of Ferrograph tape machines; sold the first speakers with polymer cones and the first speakers with magnetic suspension. His many friends and colleagues will remember him as a gentlemen. He was an individual who not only distinguished himself and his company, but who added a dignity to the high fidelity trade.

SUBSCRIPTION RATE CHANGE

Effective with the June 1980 issue of db—**The Sound Engineering Magazine** there will be a change in the subscription price. The new rates will be:

U.S.
- 1 year —$12.00
- 2 years—$22.00
- 3 years—$30.00

Canadian
- 1 year —$13.00
- 2 years—$23.00
- 3 years—$31.00

Foreign
- 1 year —$24.00
- 2 years—$44.00
- 3 years—$60.00

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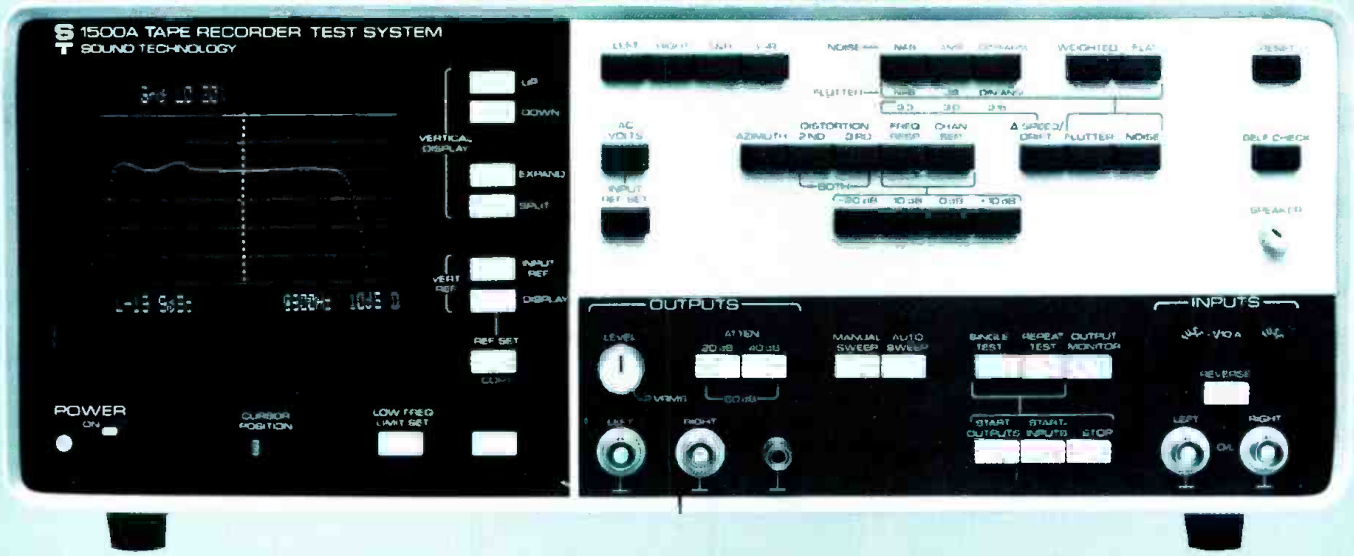


How to check your tape recorder in ten minutes

Graph-type display with digital readout

If you haven't actually measured the performance of your audio tape recorder lately, there's a better than 50-50 chance it's much poorer than you think. That's what considerable experience shows.

Checking ATR's is now simplicity itself. All you do is connect your recorder to the new Sound Tech computerized Tape Recorder Test System.

Just by pushing panel buttons you can measure:

- Frequency response
- Harmonic distortion
- Wow and flutter
- Noise
- Speed accuracy and drift
- Channel separation
- Head azimuth accuracy (position a head in 10 seconds)

Information-packed display

The display system in the New Model 1500A gives you all the information you want. Frequency response, distortion, noise, flutter, head azimuth, and channel separation are displayed as graphs with the scale values shown in numbers.

Then you have a positionable cursor (vertical dashed trace in photos). At whatever frequency, level, etc., you place it, the measured value will be shown on the screen in numbers.

Just by pushing buttons you can fully test your recorder almost in seconds.

Call now

The Model 1500A is already used by manufacturers.

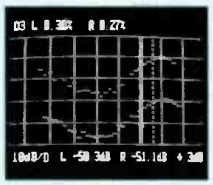
They love it.

You will, too. You can clean up your audio a whole lot easier than you ever imagined.

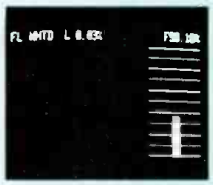
So call Mike Hogue or Larry Maguire at Sound Tech now for our sales literature.

This new computerized test system is popular and you should get informed about it.

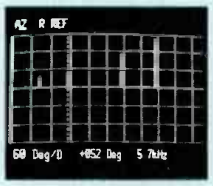
Two channel frequency response



Third harmonic distortion vs. level

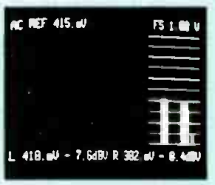


Flutter: 0.03% shown



Head azimuth accuracy

Noise; two channels; —61 dB shown



Voltage (yes, it's a voltmeter, too)

SOUND TECHNOLOGY
1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
(408) 378-6540
In Toronto: The Pringle Group

Circle 11 on Reader Service Card

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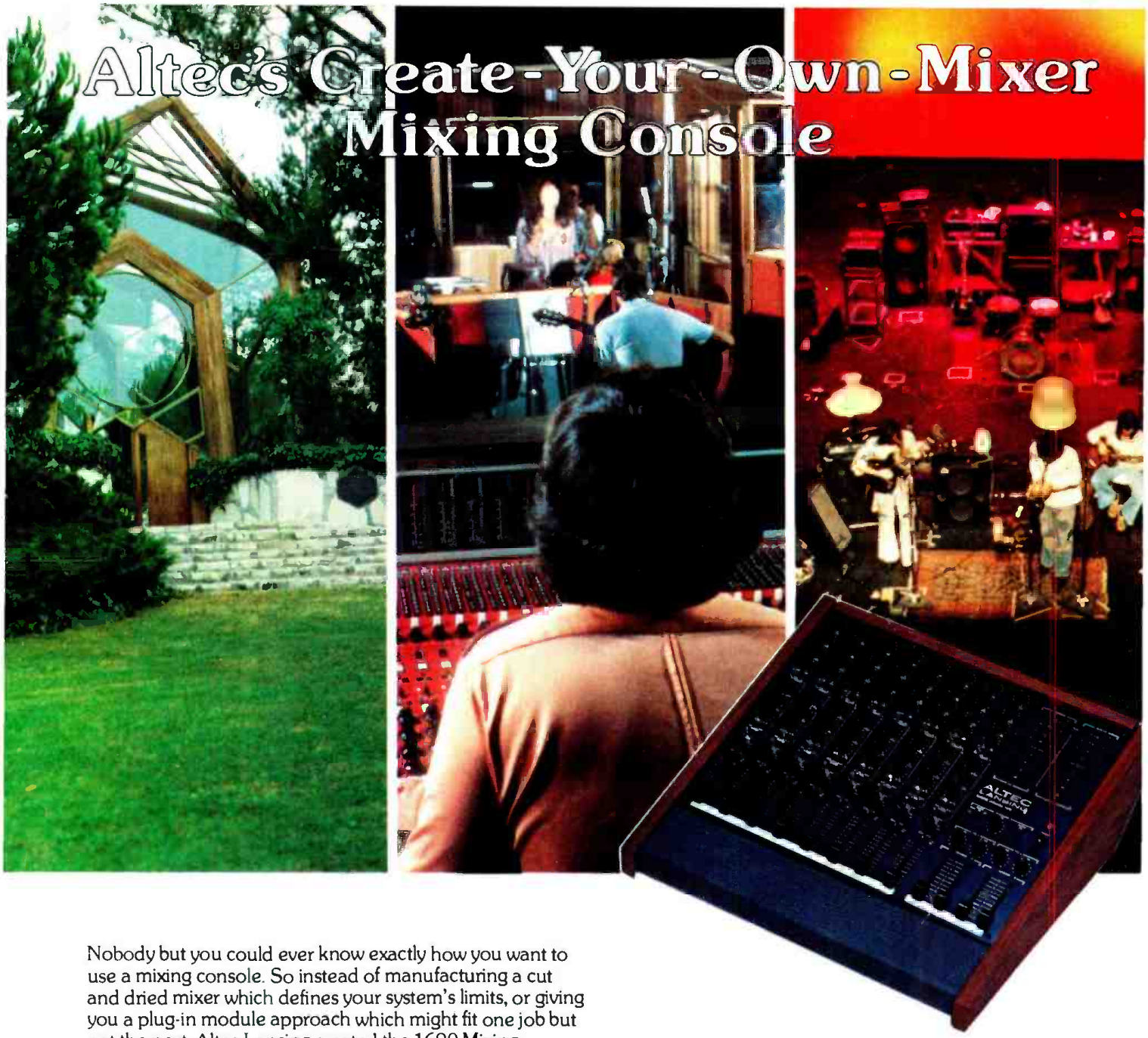
Altec's Create-Your-Own-Mixer Mixing Console



Nobody but you could ever know exactly how you want to use a mixing console. So instead of manufacturing a cut and dried mixer which defines your system's limits, or giving you a plug-in module approach which might fit one job but not the next, Altec Lansing created the 1690 Mixing Console to give you options rather than boundaries.

No longer do you have to struggle to fit your needs into the circuitry of someone else's idea of a perfect mixing console. A mere flick of the mode switch on any of the 1690's eight input channels lets you select the channel circuitry best suited for your musical or commercial sound reinforcement, recording/overdub or mixdown applications.

If your needs change in an hour, no matter. Just flick the switch and turn the 1690 into a whole new mixer.

PA/REC/MIX Mode Switch

And, two or more 1690's linked together can give you twice the flexibility and twice the performance.

We have written a comprehensive technical letter to explain in more detail just how simply you can turn your ideal system designs into reality.

So go ahead, design your ideal system. With your ideas combined with our technology, you can easily "create-your-own-mixer" on Altec Lansing's 1690 Mixing Console. Another innovative product from the company that speaks with the Voice of Experience—with 43 years manufacturing quality audio products for America and for the world.

For further information write Altec Lansing, 1515 South Manchester Avenue, Anaheim, California 92803 or check the yellow pages under "Sound Systems" for the name of your nearest Altec Sound Contractor.

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